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# A DICTIONARY

OF

# MEDICINE

INCLUDING

GENERAL PATHOLOGY, GENERAL THERAPEUTICS,
HYGIENE, AND THE DISEASES PECULIAR
TO WOMEN AND CHILDREN

*BY VARIOUS WRITERS*

EDITED BY

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ETC.

FOURTEENTH THOUSAND

*PART II.*

*MACULÆ to ZYME and APPENDIX*

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**MACULÆ** (*macula*, a spot or stain).—Synon.: Fr. *Macules*; Ger. *Flecke*.

Description.—Willan's definition of macula is 'a permanent discoloration of some portion of the skin;' and that author adopted the term as the title of his eighth order of cutaneous affections, including sunburn, nævus, and spilus. The term macula is likewise applied to a hyperæmic state of the skin, which may be simply chronic without being permanent, such as those which have received the name of *maculæ syphiliticæ*. Maculæ, therefore, may be merely pigmentary, and located in the rete mucosum alone; or they may be hæmostatic or hæmorrhagic, and be seated in the derma and subcutaneous tissues. Sunburn, freckles, liver-spot, bronzed and melasmic spots, and the stains left on the skin after the dispersion of certain cutaneous eruptions, such as lepra vulgaris, acne, lichen planus, syphilis, and elephantiasis, are examples of pigmentary maculæ, whilst leucosmic spots and blotches represent an absence of pigment. The maculæ resulting from a permanent hyperæmia of the blood-vessels of the skin, such as flat vascular nævi and the claret-stain nævus, are hæmostatic and disappear under pressure; whilst the hæmorrhagic maculæ are represented by the escape of the red corpuscles of the blood from the vessels, and their diffusion in the connective tissues, such as occurs in purpura and in bruises.

Treatment.—The therapeutics of maculæ will be found treated of under the heads of pigmentary affections of the skin, and of the respective diseases with which they are associated.

Erasmus Wilson.

**MADEIRA; North Atlantic Ocean.**—Moist, mild, equable, relaxing climate. Mean temperature in winter, 60·6° Fahr. Prevailing wind N.E. *See* Climate, Treatment of Disease by.

**MADNESS.** *See* Insanity.

**MADURA-FOOT.**—A synonym for fungus-foot of India. *See* Fungus-Disease of India.

**MAGGOTS.**—A popular term for the parasitic larvæ of various insects, including bots. *See* Œstrus.

**MAGNETISM, ANIMAL.**—This name was formerly applied to the imaginary new force or principle, supposed to be akin to magnetism, and to be in operation when individuals were 'mesmerised.' This hypothetical new force was thought to be called into play by the mesmeriser; and it was deemed to be by virtue of its influence that the will, thoughts, and actions of the 'medium,' or person mesmerised, are capable of being influenced in the so-called mesmeric trance or sleep. This view as to the nature of the causal conditions is now regarded as altogether erroneous, although certain remarkable effects appear to have been produced on many persons by so-called 'mesmeric passes,' or other means, owing to the induction in such persons, under physiological conditions, of some at present imperfectly understood state or modification of cerebral activity (*see* Mesmerism). This state is now generally spoken of as the 'hypnotic condition,' 'hypnotic sleep,' or 'hypnotism'; or more rarely as 'induced somnambulism.' On the other hand, when such a state is induced, as a therapeutic means or agency, it has been spoken of as 'Braidism.' *See* Braidism.

H. Charlton Bastian.

**MALACOSIS** (μαλακὸς, soft).—A term for the morbid softening of structures. *See* Softening.

**MALACOSTEON** (μαλακὸς, soft, and ὀστέον, a bone).—A peculiar disease of bone, characterised by softening. *See* Mollities Ossium.

**MALAGA, in South of Spain.**—Dry, mild, bracing, equable climate. Mean temperature in winter, 55° Fahr. Winds: N.W. (*Terral*), dry and dusty; E. (*Levante*), cold and damp. Drawbacks: bad drainage and cookery. *See* Climate, Treatment of Disease by.

**MALAISE** (Fr.)—Synon.: Indisposition; Ger. *Missbefinden*.—In cases of simple digestive derangement, in ague, and in the stage of invasion of many acute diseases, the patient very commonly first becomes aware that his health is disturbed by a feeling of general illness, which is known as malaise.

Description.—Under the circumstances just mentioned, the ordinarily unconscious feeling of being well, or *bien-être*, which accompanies perfect health, is replaced by a painful and depressing feeling, which the patient probably cannot describe otherwise than as a sense of being weak, languid, listless, and disinclined to bodily or mental exertion. Malaise is commonly associated with bodily debility, chilliness or actual rigors, moderate pyrexia, general pains or aches, giddiness, headache, and anorexia. In the course of the more serious diseases in which it occurs, malaise either passes off or soon gives place to more urgent symptoms—such as depression, apathy, delirium, or stupor; but in other instances it persists, and constitutes the chief subjective phenomenon of the disease, as in some cases of typhoid fever.

Treatment.—The treatment of malaise will depend upon the nature of the cause of the feelings just described, and should be directed to its removal or remedy. J. Mitchell Bruce.

**MALARIA** (Ital.).—Synon.: Marsh Miasm.; Fr. *Mauvais Air*; *Intoxication des Marais*; *Intoxication Tellurique*; Ger. *Malaria*.

Definition.—An earthborn poison, generated in soils the energies of which are not expended in the growth and sustenance of healthy vegetation. By almost universal consent this poison is the cause of all the types of intermittent and

remittent fevers, commonly called *malarial*, and of the degeneration of the blood and tissues resulting from long residence in places where this poison is generated.

The Italian word *malaria* is now employed to convey the meaning expressed in the above definition. It is certainly preferable to the term *marsh miasm*, which implies that marshes are the sole source of the poison. M. Léon Colin, Professor of Military Medicine in the Val-de-Grace, who has written an instructive work on malarial fevers, does not use the term malaria to distinguish the agent that causes them; he prefers the term telluric poison, *intoxication tellurique*, proceeding from the energy of the soil, when that energy is not absorbed by its natural consumers, crops or plants—in a word, healthy vegetation. This telluric influence or poison is, however, after all, a malaria, a bad or poisonous air under another name.

Essential Nature.—Chemists have not been able to demonstrate the presence of a malaria—a fever-generating agent—in the air of marshes, any more than they have been able so to do in other places where the same fevers prevail. Much light has, however, been thrown upon the intimate nature of the malarial poison, by the researches of Professors Tommasi Crudeli, of Rome, and Klebs, of Prague, who made the physical cause or poison to which malarial fevers are due the subject of careful investigation in the *Agro Romano*, in the spring season of 1879. They examined minutely the lower strata of the atmosphere of the district in question, as well as its soil and stagnant waters; and in the two former they discovered 'a microscopic fungus, consisting of numerous movable shining spores, of a longish oval shape, and nine *micromillimètres* in diameter. This fungus was afterwards artificially generated in various kinds of soil; the fluid matter thus obtained was filtered, and repeatedly washed; and the residuum left after filtration was introduced under the skin of healthy dogs. The same thing was done with the microscopical particles obtained by washing large quantities of the surface soil. All the animals experimented upon had the fever, with the regular typical course, showing free intervals, lasting various lengths of time up to sixty hours, and an increase of the temperature of the blood during the shivering fits up to nearly 42° C.; the normal temperature in healthy dogs being from 38° to 39° centigrade. The animals affected by intermittent fever showed precisely the same acute enlargement of the spleen as human patients who had caught the disease in the usual way; and in the spleens of these animals a large quantity of the characteristic form of fungus was present.' Tommasi Crudeli and Klebs have given to this organism the name of *Bacillus malariæ*.

Doctors Marchiafava and Valenti, of Rome, affirm that they have detected the *Bacillus malariæ* in human patients, in a more advanced stage than in the animals operated upon by Crudeli and Klebs. Dr. Crudeli still more recently states, as the result of further pathological investigations, that the bacilli may always be found in the blood during the period of invasion of the fever; but that during the acme they disappear, and spores only can be discovered. The bacilli have been found chiefly in the spleen of the human subject; and in the marrow of bones in animals experimented on. The bacillus has not yet been found in Bengal. According to the researches of Laveran, extended and corrected by Richard, the blood in malarial fever contains, during the accession, spherical organisms, developed in connexion with the red corpuscles, and furnished with filaments; also certain curved and pointed bodies, which are only infected and deformed corpuscles. The pigment granules of malarial blood are produced in the red corpuscles during the growth of the organisms. *Lancet*, 1882, vol. i. p. 993. Should future investigations by independent observers in other malarial regions confirm these conclusions, it would be difficult to overrate their importance.

Genetic Relations.—When we consider that in many regions of the globe two-thirds of the mortality is caused by the fevers, and their sequels, to which this poison gives rise, we can understand why all that relates to malaria is important to the statesman, the soldier, the sanitarian, and the physician. 'Fevers,' says Dr. Cornish, the Sanitary Commissioner of Madras, 'one year with another destroy twice as many people in India as small-pox, cholera, and all other epidemic causes put together.' Dr. Parkes has well said 'that when a climate is called "unhealthy," it is simply meant that it is malarious.' This remark is especially true of tropical climates. Malaria has generally been said to be the product of heat, moisture, and vegetable decomposition. The terms *marsh miasm*, and *paludal fevers*, long employed to distinguish the poison and the fevers to which it gives rise, mark the almost universal belief that the air of marshes alone is endowed with the power of generating them. That low, moist, and warm localities are generally noted as malarious is indisputable. Marshes are not, as a rule, dangerous when abundantly covered with water; it is when the water level is lowered, and the saturated soil is exposed to the drying influence of a high temperature and the direct rays of the sun, that this poison is evolved in abundance. The production of malaria on a great scale in this way was seen in the district of Burdwan, in Bengal. The soil is alluvial, but dry; and, until within the last few years, Burdwan was more salubrious than the central or eastern districts of the Lower Gangetic delta. The drainage of the district became obstructed by the silting up of its natural and artificial outlets, the result being a waterlogged condition of the soil, the development of malaria, and an alarming increase in the death-rate.

Malaria is, however, generated under conditions apparently widely different from the above. When the British Army under Wellington was operating in Estremadura, the country was so arid and dry for want of rain, that the rivers and small streams were reduced to mere lines of widely detached pools; yet it was assailed by a remittent fever of such destructive malignity 'that,' says Ferguson, who records the fact, 'the enemy and all Europe believed that the British host was extirpated.' A fever of like malignity scourged the same army in the bare open country by which Ciudad Rodrigo is approached from the side of Portugal, at a time when, says the same author, 'the vegetation was so burned up that the whole country resembled a brick-ground.' It

must, however, be kept in mind that both districts are in the rainy season flooded with water, at which time they are healthy, until the drying process begins under the action of a powerful sun.

Malaria is notoriously rife in soils the upper strata of which are rich in organic matter, and are from any cause left to nature and the influence of the sun. The Roman Campagna[1] is a well-known example of this kind. M. Léon Colin has explored this tract of country in search of the commonly recognised sources of malaria, and reports it everywhere dry and free from stagnant water. But the cultivating hand of man has long been withdrawn from this once fertile region, and the energies of its rich soil, instead of being directed to food-producing ends, are wholly given up to the development of malaria, for which it is notorious.

It is well known that so-called malarial fevers prevail in some of the most sterile regions of the earth. Here, it is often said, 'there is no organic matter, no vegetative energy running waste, on which to fall back for an explanation.' Yet many of those desert places, to all appearance under the curse of perpetual barrenness, do contain organic matter, and are in reality so full of vegetative energy, that water only is wanted to fit them for the productive labour of the husbandman. There are millions of acres in India, now supplying abundant harvests, which, if water was withdrawn, and the cultivating hand of man withheld, would quickly relapse into deserts fruitful only in malaria.

We need not go to tropical countries in search of examples of this kind: our own country can furnish them in abundance. So late as the reign of the sister of Elizabeth, 'to whose name a horrible epithet adheres,' large tracts of country from political causes fell out of cereal cultivation, and forthwith malarial fevers became epidemic, attended with a heavy mortality.

The disturbance of soil that has long been fallow is often followed, both in hot and temperate climates, by the evolution of malaria. A familiar example was the prevalence of intermittent fever in Paris during the construction of the Canal St. Martin; also during the excavations for the fortifications of the same city, in the reign of Louis Philippe; and on a larger scale in different parts of France when the railways were in process of construction.

Malaria is freely generated at the bases of mountain ranges in tropical climates. The strip of land extending along the base of the Himalaya, called the *terrai*, is a notable example of this kind. The soil of this region is immensely rich, well supplied with water, and covered with dense forests, which with the vast mountain range makes free perflation of air impossible. At particular seasons of the year it is almost certain death to enter this region.

Some rocks in a state of disintegration, when freely exposed to the drying action of the sun and air, are in tropical countries often highly malarious, and give rise to severe forms of fever. The example most familiar to the writer from personal knowledge is the island of Hong-Kong. The soil, according to Dr. Parkes, contains only about 2 per cent. of organic matter; but like all granitic rocks it is highly absorbent of water; and Friedell, quoted by the same authority, affirms that it is permeated by fungi. The writer was encamped on this island before it was ceded to the British Government. At this time the soil was but little disturbed, and the troops did not suffer. But when excavations were made at a subsequent time, for the construction of the city of Victoria, on the side of the island facing the harbour, a fatal form of remittent fever appeared, which caused great mortality among both the civil and the military population.

Parkes (*Practical Hygiene*) thus sums up his account of the soils with the largest organic emanations: '1. Alluvial soils, old estuaries, deltas. Peaty soils are much less malarious. Marshes overflowed regularly by the sea are often healthy, while the occasional admixture of salt water increases the emanations. 2. Sands, if there is an impermiable clay or marly subsoil. Old watercourses. 3. The lower parts of the chalk, where there is a subsoil of gault or clay. 4. Weathered granitic or trap rocks, if vegetable matter has become intermixed; such soils absorb both heat and water. 5. Rich vegetable soils at the foot of hills.'

When malarial fevers appear in ships returning from unhealthy climates, the explanation is to be looked for under one or other of the following causes:—(*a*) the sufferers may have had their systems charged with malaria before embarkation, as is constantly seen in the case of invalids returning from India; (*b*) they may have used water on board drawn from a malarious locality; (*c*) the source of the malaria may be in the ship, from decayed vegetable matter mingling with the bilge water, in ships under a bad sanitary *régime*;[1] or (*d*) it may be derived from malarious mud, as in the case of H.M. ship 'Powerful,' returning from India, when a severe outbreak of fever was traced to this cause. There is, however, reason to believe that when fever has been observed to follow the consumption of unwholesome water at sea, it has sometimes been not malarial but enteric, from the unsuspected presence in it of the specific germs of that disease.

Instances are also recorded, in which symptoms having a periodic character, and yielding to the treatment which is effective in malarial diseases, have resulted from exposure to decaying vegetable matter, a connection of which with a special marsh poison could not well be traced.

Attributes. — Malaria, however generated, possesses certain properties well known to those who live in malarial localities. Temperature exercises great influence over its development and activity; many places can be visited with impunity in winter which are dangerous in summer and autumn. Wenzel made observations on the effect of temperature in the development

[1] Every sanitarian must wish success to the gigantic schemes suggested by Garibaldi to make Rome fit in a sanitary point of view for the capital of Italy, and to purify the pestilential Agro Romano. In the present state of matters Rome is unsuitable for a capital, except for reasons purely sentimental.

[1] The writer is indebted to the late Dr. Mansfield, R.N., for an instructive example of a fatal form of yellow malarial fever on board H.M. ship 'Egmont,' long used as a storeship at Rio. The ship was found to be in a state of decay; the timbers were permeated by fungi of a white or cream colour, giving off a sickening and offensive odour.

of malaria during the construction of the fortified port of Jahde; he observed that the increase of attacks of malarial fever was coincident with a rise in the temperature. In the charts constructed by him to illustrate the point, a constant precedence of the temperature curve by twenty or twenty-five days of the sickness curve of attacks is to be seen; so that in a temperate climate like that of Jahde, three weeks of increased temperature appeared to be necessary for the genesis of the malarial poison, and the outbreak of sickness. When in any year the medium summer temperature did not reach 12° R. (59° F.) the sickness remained at its minimum.

Malaria drifts along plains to a considerable distance from its source, when aided by winds sufficiently strong to propel, but not to dispel it. Under the influence of currents of heated air it can ascend, in dangerous concentration, far above its source, and buildings elevated some hundreds of feet above a malarious plain are often more under its influence than those on the plain itself. When favoured by ravines and currents of heated air, it can scale mountains to a height which appears to differ in different climates, varying from four or five hundred to two or three thousand feet. It is unsafe to place human habitations on the edge of such ravines on mountain tracts generally considered above 'fever-range.' A belt of forest interposed between any malarial place and human habitations affords considerable protection, and a sheet of water similarly placed exercises an absorbing power—facts long familiar to sanitarians. Soils protected from the sun's rays by forest trees are generally healthy; but when exposed to the sun after the forests have been cleared away, malaria is evolved until the land is brought under cultivation.[1]

Pathological Relations.—The physician can demonstrate the existence of malaria by the best of all tests, namely, its pathological action. This action has been recognised for ages in the property it possesses of producing a class of fevers distinct from all others in their symptoms and sequels, to which the name of *malarial* or *paroxysmal* has been given; the latter term from the almost clock-like regularity of the periods of apyrexia and recurrence. Pathologists have also recognised its power of impressing on other disorders, in a lesser degree, the same stamp of periodicity, and its more insidious but not less dangerous endowment of inducing that 'slow blight of the constitutional powers' to which the term *malarial cachexia* is now applied. The most striking features of this condition are easily recognised. The sufferers appear much older than they are; the skin assumes a brownish yellow tint, of various shades, according to the natural complexion of the person and length of residence in an unhealthy climate. They become anæmic, with an immense increase in the white corpuscles of the blood. The rapidity with which this anæmia is developed is surprising. Professor Kelsch has shown by carefully conducted observations made by Malassez's method, that in twenty-four hours a man affected with intermittent fever lost more than a million of globules per millimètre cube. This condition of the blood often gives rise to murmurs, not confined to the cardiac region, but heard also in the large vessels, misleading unwary observers into a false diagnosis of organic disease. Persons whose blood is thus so affected are prone to attacks of a fatal form of pneumonia, if exposed to cold when not protected by sufficiently warm clothing. Their digestive and heat-generating powers are impaired, and they are liable to diarrhœa from slight causes, often of an intractable kind. The liver is generally enlarged, but the most characteristic lesion is enlargement of the spleen, which often attains such a size as to occupy a large part of the abdominal cavity. There is in the pathological museum at Netley a preparation of the section of a spleen taken from the body of a small drummer boy, who had been under the care of the writer. This lad had spent some years of his brief life in the Peshawur Valley. The weight of the spleen was 10 lbs. 15 oz., that of the liver 9 lbs. 10 ozs. The condition was alike in both organs, an immense development of connective tissue having taken place. These two organs made up one quarter of the total body-weight of the boy. Both spleen and liver, and sometimes even the brain and spinal cord, are deeply pigmented. The urine is sometimes albuminous, with œdema of the lower extremities—symptoms suggestive of Bright's disease, leading to a grave prognosis, often ill-founded, as the above symptoms usually disappear under good climatic and therapeutic means.

Neuralgic affections, varied and numerous, are common sequels of malarial poisoning; 'brow ache' is a familiar example. To the above may be added palpitation of the heart, rheumatic pains in limbs and joints, and amenorrhœa; and if, as often happens, scurvy be engrafted on the malarial cachexia, such of the above affections as may be present are at once seriously aggravated.

Tropical dysentery prevails in its worst forms in malarial localities; the same is true of suppurative inflammation of the liver. It seems probable that when malaria acts as a predisposing cause of dysentery, it is taken into the system through the medium of water. It is a significant fact, elsewhere insisted on by the writer, that exactly in proportion as we have banished malaria from the soil of the British Islands, so has dysentery disappeared as an endemic disease.

The late Dr. Cutchliffe, of the Bengal army, noticed that in some very malarious districts in the Bengal Presidency, large numbers of males were impotent, the women proving fruitful with males from other non-malarious regions. In such localities, also, the children of those affected are often born, not only with the external signs of the malarial cachexia, but also with the visceral changes and pigmented organs described above.

[1] A popular belief has arisen that the blue gum tree of Australia, Eucalyptus Globulus, is particularly efficacious in this way. This tree is now popularly known as the 'fever tree,' and is being extensively planted for protective purposes in the malarious parts of Italy. Its supposed virtues are said to be due to the camphoracious constitution of the leaves of this noble, gigantic, and rapidly-growing tree. It is a notable fact that the extensive pasture lands of Australia are very free from malaria, and the fact is there attributed to the existence of vast forests of the blue gum tree.

All the species of eucalyptus grow with amazing rapidity; wherever they are planted they are great consumers of moisture, and thus exercise a drying influence on the subsoil, which must have a considerable effect on the climate where they exist in large numbers.

Since we cannot yet affirm that the essential nature of the malarial poison has been discovered, we may notice two other theories that have been advanced. It need only be said of the few who maintain that the grave pathological changes attributed to malaria are all explicable either on the hypothesis of 'chill,' according to Dr. Oldham, or 'certain electrical conditions,' according to Dr. Munro, that they have a difficult thesis to support. If 'chill' will account for the loss of 10,000 men at Walcheren, for the frightful disaster of a like kind at Carthagena, for the terrible visitation of paroxysmal fevers in the Mauritius, and countless examples of the same kind, and for the yearly loss of life in India from fevers—the country in which Dr. Oldham serves, why, seeing that mankind are exposed to 'chill' everywhere, are not such fevers with their sequels universal in their prevalence, instead of being confined to places under one or other of the conditions described in this article? Why, above all, in a country like Great Britain, where vast multitudes of the population are hourly exposed to every variety of atmospheric change, have paroxysmal fevers, once endemic there, disappeared, save in such exceptional places as are still under one or other of the conditions described above? No satisfactory answer has been given to this question. As for the 'electrical conditions' of the other hypothesis, when its author can explain what these conditions are, and why they no longer exist in the British Islands, or do not produce their usual effects, we shall be prepared to discuss their value from a pathological point of view.

W. C. Maclean.

**MALARIAL.**—Pertaining to or connected with malaria; for example, *malarial fever*, *malarial region*, *malarial poison*. *See* Malaria.

**MALFORMATIONS** (*male*, amiss, and *formo*, I fashion).—Synon.: Fr. *Malformations*; Ger. *Missbildungen*.

Definition.—Deviations from the normal standard, in the size, form, number, or situation of any part or organ of the body.

Varieties and Ætiology.—The malformations of the human body may be conveniently considered under two distinct heads, namely—(A) *Acquired* malformations, more commonly called *deformities*; and (B) *Congenital* malformations.

A. *Acquired Deformities.*—Acquired deformities may be the result of disease, affecting, for instance, the spine, which may become curved, or the joints, or the tendons. Similarly, the bones may be the seat of deformity, as in rickets, mollities ossium, or osteitis. Certain injuries and accidents, such as burns, scalds, fractures, and dislocations, lead also to a great number and variety of deformities. Various habits, customs, and occupations, by giving rise to pressure on certain parts of the body, by altering the amount of blood circulating through them, or by interfering with their due innervation, bring about changes in the relative size and shape of the bony or soft textures, and so lead to malformations. It is thus that the brow is flattened by certain tribes of American Indians; the waist deformed, and the corresponding viscera compressed and dislocated, by means of the tight-lacing practised by more civilized peoples; and the feet distorted by many nations, especially the Chinese. Not only is such a striking example as the common depression of the lower part of the sternum in shoemakers a deformity, but the huge development of certain groups of muscles at the expense of others induced by some occupations, must be looked upon in the same light, for these, too, are deviations from the normal outline of the human figure. Besides these cases, which may be termed primary malformations, many others of a secondary character, that is, dependent on some antecedent change or lesion, are frequently seen. These may occur in organs correlated in growth, as the absence of hair on the face and pubes, and the increase of subcutaneous fat, if from any cause the testicles waste, or if they are removed before puberty. Absence of, or disease in, any part which causes the disuse of other parts, also induces a secondary deformity, as the atrophy and degeneration of a group of muscles, or of a limb, when the nervous supply is in any way interrupted either at the centre or the periphery. The brief reference which has been made to these acquired malformations will suffice, and this article will be devoted to a consideration of the large class of congenital deformities, and of these to such only as are of a general character. Special malformations of organs will be noticed with the diseases of those organs, such as the brain, heart, and liver. Deformities of the chest, which are a subject of the greatest interest to the practitioner, are also separately discussed. *See* Deformities of the Chest.



B. *Congenital Malformations.*—Since the appearance of the classic work of Isid. Geoffroy St. Hilaire, congenital malformations have been grouped and classified, and their causes determined with such approximate accuracy, that, in place of the superstitious beliefs and incredible absurdities which formerly prevailed, a distinct branch of pathological anatomy has been established, namely, that of Teratology. Instead of considering a monstrosity as a presage of some misfortune, a proof of divine vengeance, an effect of witchcraft, the result of intercourse with the lower animals, with demons, or even with women during menstruation or pregnancy, we now trace it either to a malformation of the original germ, or to some cause interfering with its development, and inducing either an excess or a deficiency of parts or organs. Starting from the normal standard, we find varieties in development of all kinds in two complete series, namely, an ascending series, from a mere supernumerary digit to double or even triple monsters; and a descending series, from the mere default of a digit or organ, or the union of digits, to monsters with scarcely a trace of human structure, forming an almost shapeless mass. Besides these, we may have excess or defect in the size and development of various organs and parts, or of the body *en masse*, leading to the formation of giants and of dwarfs. In other cases, development and size are normal, but the viscera are transposed, and this, too, may be either general or partial. From the moment of fecundation the ovum is exposed to various influences, which may alter its normal development; and it depends on whether it is

subjected to these at an early or a late stage, as to whether complex or simple anomalies result.

**1. Malformations by Excess.**—Reference will first be made to the formation of monsters by excess. Two ova may be formed in one Graafian vesicle, for double-yelked eggs are well known; but there is no evidence to show that these would form a double monster. Indeed, Professor Allen Thomson found on incubating a dozen of such eggs, that not one produced a double embryo; whilst Wolff observed two completely separate fœtuses developed upon a single yelk. The arrival of two impregnated ova in the uterus at the same time will probably give rise, not to double monsters, but to twins, and their fusion seems almost impossible. We are thus led to the opinion that monsters by excess depend on an error of development taking place in a single germ; and this idea is more readily tenable since Allen Thomson has shown that, in birds, two primitive grooves may be formed on one yelk and in one *area germinativa*, for in this way the most complete cases of double monstrosity can be explained. In confirmation of this theory, the researches of Lereboullet may be quoted. This observer has seen, instead of the single budding of the blastoderma, which is ordinarily developed into the embryo of the fish, two or even three buds marked off; and these, during the process of development would meet at some point, and in this manner produce parts of distinct embryos where they are separate, whilst a corresponding region of a single organism only would be formed at the point of junction. According to the mode and extent of the junction of the blastodermic buds, the monsters would vary; and so would be derived all the different varieties, from a duplicity of the face or head, the upper or lower extremities, to such extreme cases as the Hungarian sisters, and the Siamese twins, who were joined by the xiphoid cartilage only, and the twin negresses (Millie and Christine) who are united by their lower lumbar vertebræ, sacrum and coccyx. In these cases all the viscera are not completely isolated and double, for in the Siamese twins three peritoneal prolongations were found in the connecting band, and there was a vascular communication between their two livers. In the case of Millie and Christine, there is a single anus and a single vulva, but two hymens, two clitorides, and very probably two vaginæ and uteri. The Hungarian sisters, Helen and Judith, had but one vaginal orifice, although the upper part of that organ was divided into two, and the two intestines met in a single anus, placed between the four thighs. The Bohemian sisters Rosalie and Josepha, more recently exhibited, in whom there is a junction of the posterior wall of the pelvis, present apparently a single urethra and a single anus, but a double vagina. Still more curious are the monstrosities which are only united by their vertex, as the cephalopages, where the two fœtuses are placed end to end; and the metopages, where they are placed parallel, face to face, and sternum to sternum. In one of these cases, two normal brains, completely separated by their membranes, were found on dissection. These compound monsters always have a single chorion, a single amnion, and a single placenta, though the umbilical cord may be double. They are always of the same sex, and their capability of living depends on their having an almost completely double organisation, or on one individual being reduced to such a state of atrophy as to be a mere appendage to the other, who is almost normal in other respects. The condition of the brain and of the heart are the most important factors with regard to their viability. They have never transmitted their peculiarities to their offspring.

**2. Parasitic Monsters.**—The parasitic family of monsters are characterised by a more or less rudimentary individual being implanted on, and growing at the expense of, another who is fully formed. This parasite may either exist as a supernumerary head, or limbs, or may be almost complete; it may grow from the head, maxillæ, or lower part of the trunk; and when the genitals exist, it is found to be of the same sex as the chief individual. Some of these cases attain to adult life, and if they have any children, these are well-formed. From such instances the transition is easy to those monsters in which the parasite is either included under the skin, or even, during the approximation of the visceral laminæ, becomes implanted inside the abdominal cavity, as is well seen in a specimen in the Hunterian Museum of the College of Surgeons. In these an arm, a leg, or a hand may be found; fragments of bone are common; and even nervous, muscular, or glandular structures may occur. A fibrous capsule is formed around these vestiges, and if they are sufficiently nourished from without, they may live a kind of vegetative life; but more frequently they degenerate or decompose by contact with the air, and so cause the death of their host.

**3. Malformations by Deficiency.**—In the case of monstrosities by deficiency, we again have every grade, from those almost without human form, to the simplest malformation due to a non-development or defective union of some parts of the embryo. The acardiac monsters are always products of a twin conception; and the amount of their development depends on the period of its arrest, and on the degree of anastomosis between their umbilical vessels and those of the normal fœtus. Slighter malformations are caused by physical or mechanical influences acting on a single individual, or by some pathological lesion. Panum and Dareste, by experiments on this subject, have shown that different degrees of heat, and mechanical shocks always lead to some malformation, and that the same agency always produces the same malformation. Lesions of the amnion and placenta, and twisting of the funis around the fœtus, are fertile causes of deformity. On dissection a large number of deviations are found to be dependent on inflammatory processes, causing morbid adhesions and serous effusions. These interfere with nutrition, and so lead to an arrest of development. Again, as in after-life so in the embryo, a primary lesion may induce a secondary one, as when club-feet are caused by a defect in the nervous centres. In the production of malformations, causes of a general nature affecting the parents must not be left out of consideration; for syphilis, chronic alcoholism,

and hereditary influences are undoubtedly very potent factors. The writer attaches but very little importance to Demeaux's suggestion—unsupported as it is by any valid evidence—that copulation in a state of drunkenness may engender malformations; but he is inclined to give more credit to maternal impressions during pregnancy as an agent in some of these cases. Many examples which are ascribed to such influences are undoubtedly due to other causes; but the numerous well-attested instances in physiological treatises, which prove the effects of both prolonged, and sudden, but intense, emotion on the process of secretion, must make one pause before dogmatically asserting that the nutrition and development of the embryo cannot be interfered with in a similar manner.

4. **Transpositions.**—Transposition may affect the entire organism in some of the lower classes of animals, as in certain fishes and molluscs, but in man this is limited to the thoracic and abdominal viscera. The organs normally situated on the right side are placed on the left, and *vice versâ*; whilst those which occupy the median plane are so rotated that the parts which should be found on one side of the mesial line are displaced to the other. Such transposition varies in degree in different cases, sometimes affecting all the viscera, at other times merely one or two organs. The more general cases are stated by Dareste to be due to the embryo-heart taking a turn in its early development to the left instead of to the right, which is its normal change. He has artificially produced similar deformities by incubating eggs placed obliquely, so as to subject their extremities to unequal degrees of heat, and cause an excess of development on one side. Bischoff, however, attributes them to an alteration in the normal position of the umbilical vesicle and allantois, so that the former turns to the left and the latter to the right, and suggests that this might possibly influence the site of the internal organs.

A variety of malformations, such as hare-lip, cleft palate, imperforate anus or vagina, club-foot, and webbed fingers, are subjects which belong to surgery, and do not require further notice here.

Treatment.—Many malformations, especially such as belong to the class of acquired deformities, admit of benefit by treatment, but as such treatment is of a purely surgical kind, it does not require to be discussed in the present work.

John Curnow.

**MALIGNANT CHOLERA.** A synonym for Asiatic cholera. *See* Cholera.

**MALIGNANT DISEASES.**—This term is applied to certain diseases or types of a disease which tend towards a fatal issue. First, it is applied to such diseases as cancer, which essentially lead to the destruction of life; and secondly, to certain varieties of fevers and other acute affections, such as typhoid fever, scarlet fever, smallpox, and cholera, which present peculiarly grave and aggravated symptoms, and generally end in death. *See* Cancer; Smallpox; &c.

**MALIGNANT PUSTULE.** *See* Pustule, Malignant.

**MALINGERING.**—Malingering, in the sense of an elaborate and carefully-planned attempt to deceive the medical man, is not very frequently met with in private practice; and although the simulation of various morbid conditions is a common complication of hysteria, the consideration of this branch of the subject will find its more natural place under the heading of Feigned Diseases. The army or prison surgeon, however, must be on his guard against imposture, and must exercise all his diagnostic skill. For his guidance many elaborate works have been written, and much information collected regarding the nefarious way in which soldiers have often outwitted their medical attendants. In our own country, under the present conditions of voluntary service, the men seldom attempt to do more than plead the excuse of some slight and temporary ailment to obtain remission from guards or drills. Headaches, rheumatism, colic, diarrhœa, and other affections of a more or less 'subjective' order, are naturally difficult of detection; but the surgeon learns gradually by experience, and seldom fails to acquire a pretty shrewd knowledge of the habitual schemer's somewhat narrow range of imposture; and hence it is that, with all its faults, the regimental system of military practice has always worked well, and enabled a sharp look-out to be kept on the troublesome malingerer, whose ingenuity is so unprofitably expended on attempts to shirk his own duties at the expense of his more industrious comrades. Occasionally, however, when the soldier urgently wishes his discharge, he is induced to lay his plans with greater decision, and to resort either to mutilation or to the imitation of chronic disease, and in Continental armies instances of this sort are comparatively common. To avoid the grievous burden of conscription, an infinite variety of artifices have been employed with greater or less success, and the ample literature of the subject bears amusing record to the ingenuity with which these inventions have been carried out. In dealing, however, with the minor degrees of malingering met with at home, we must be very careful not to be over-suspicious, and not to do injustice to a real sufferer whose symptoms seem somewhat vague and incomprehensible. Numerous cases are on record in which the mystery surrounding a fixed and obstinate pain in the back has been cleared up by the rupture of an abdominal aneurism; and Dr. Spry records, in the nineteenth volume of the *Pathological Society's Transactions*, a most instructive case in point. A typically healthy trooper of the Second Life Guards presented himself at hospital, complaining of very uncomfortable sensations in the œsophagus and stomach, following the swallowing of a bone. Some suspicion of malingering was entertained at the time; but Dr. Spry, impressed by a certain anxiety of aspect, retained the man under treatment, and three days later death suddenly ensued, and the *post-mortem* examination revealed perforation of the aorta, caused by a small spiculum of beef-bone. Facts like this are abundantly suggestive of caution, and of the happy medium between excessive sharpness and undue credulity, which a wide and intelligently used experience can alone confer. Far better is it for us to be deceived twenty times, than for

unjust suspicion to be directed to the victim of some painful and depressing disease, whose only fault may consist in his inability to supply a sufficiently clear and convincing scheme of sufferings which may be only too real.

ROBERT FARQUHARSON.

**MALPOSITION OF ORGANS.** *See* ORGANS, Displacement of.

**MALTA.**—Warm, rather moist, and very variable winter climate. *See* CLIMATE, Treatment of Disease by.

**MAMMARY GLAND, Diseases of.** *See* BREAST, Diseases of.

**MANIA** (*μανία*, fury, madness).—SYNON.: Fr. *Manie suraiguë; Délire aiguë; Fureur*; Ger. *Tobsucht; Wuth.*

Under the term mania, very distinct disorders or degrees of disorder have been described, which we shall speak of as *Acute Delirious Mania; Acute Mania*; and *Mania.*

**I. Acute Delirious Mania.**—Acute delirious mania, or maniacal delirium—whichever we prefer to call it—is something quite distinct from that ordinarily known as acute mania. The symptoms are much graver, the course is briefer and more defined, and the treatment of the one would be quite inappropriate to the other. An outburst of delirious mania may take place after very few and very short premonitory symptoms. Quite suddenly, after a few days or even hours, the patient will display the most violent excitement, which may as suddenly subside, or run a well-marked course of a few weeks; and if it does not terminate fatally will gradually decline, recovery usually taking place. Such an attack may have its origin in some sudden mental shock, as the death of a friend, a violent quarrel, a disappointment or suddenly announced misfortune; or it may arise in the course or decline of an acute disease, as pneumonia or measles. It may also come on during rheumatism; or after great fatigue, an epileptic seizure, or child-birth.

We cannot tell at first whether the attack will be transient or prolonged. We may try to cut it short by a brisk purgative, and by such medicines as chloral and bromide of potassium, and these not unfrequently answer the purpose. Sleep is procured, and perfect recovery may take place in a few days. There are patients whose organisation is so unstable that it is thrown off its balance by a cause perhaps trifling, but which produces a tremendous nerve-discharge, a complete disturbance of the whole mental functions. But so transient may this be, that one sleep restores the normal equilibrium, and the patient is cured. This condition in females is often called hysterical—hysterical mania. There is no special connection between it and the uterine functions, and it is better to retain the name hysterical mania for a variety to which it may be more appropriately given.

The delirium, however, does not always terminate quickly. If sleep becomes less and less, the mind more and more confused, and quiet and lucid intervals rarer and rarer, we may be sure that the attack will be serious and prolonged, and that careful and efficient nursing for some time will be necessary. Where a quiet and airy room can be provided, and where a patient's means are sufficient to allow him an adequate staff of attendants, an asylum is not indispensable. He will not require to take exercise in a garden; he will not be dangerous, as some are, to himself or others, though he may be violent and excited. He may be noisy, and therefore may not be able to remain unless the house is detached. The room should be lofty and cool, the windows protected and darkened; all furniture must be removed, and the bed made on mattresses placed on the floor, for he will not lie on a bedstead, and attempts to keep him there will end in bruises or more serious injury. Clothes will be torn off; but if the weather is very hot, as is so often the case during these attacks, this will be of little consequence. If it is cold, a strong suit laced up the back may be put on, and underneath it the requisite body-clothes; or a blanket may be placed round the patient, and fastened up the back.

These patients are in incessant motion, singing, shouting, and talking in a string of incoherent utterances, often repeating the same sentence again and again, or a snatch of a song or text, or a rhyme of their own composition. As a rule they are not violent, and do not attack those about them, though they may resist that which is done for them. They may be hilarious and full of glee and mischief, which is a good sign; or terror-stricken, with visions of horrible objects, which is unfavourable. They are wet and dirty; and the urine will be high-coloured, and often retained for a long period. We shall derive valuable information if we are able to take the temperature, but often that is a difficult task. A high temperature is a bad sign; and so is a rapid pulse, if it continues persistently when the patient has not been using violent exertion for some time. The tongue will often become thickly coated, dry, and brown. If it does not, but remains moist and comparatively clean, this is of good omen.

PROGNOSIS.—The prognosis in these cases is upon the whole favourable. The terminations are almost always either recovery or death. The patients are mostly young persons, who recover unless weakened by previous attacks, other disease, or child-birth. Many of the fatal cases, in the writer's experience, have been complicated by tuberculosis.

TREATMENT.—Sleep in such attacks is generally absent, sometimes for many days. Women can last longer without sleep than men, and die much less frequently in acute delirium. If sleep does not come the patient dies, and our great effort must be to promote sleep by various methods. The first question will be whether we are to give drugs to accomplish this; and if so, what drugs? Opium must not be given; it will not procure sleep, whether given by the mouth or subcutaneously. It may produce a slight narcotism for half-an-hour or so, and if we increase the dose, will cause narcotic poisoning and death; but in the height of the attack it will not procure sleep. Chloral we may try in combination with bromide of potassium, giving half-drachm doses of each, and watching the

effect. In all but the most acute cases, sleep of longer or shorter duration will be caused by these drugs; and although it may be short, it may be sufficient to save the patient's life, and enable him to battle successfully with the disorder. In the writer's experience, many more of these acutely delirious patients died before the introduction of chloral than have done since. Yet it must not be given in enormous or repeated doses, and a considerable interval should elapse between them. It may be administered easily in stout or ale, and often in wine.

Next to sleep, the most important matter is food. To enable the sufferer to withstand the exhaustion, which is the cause of death when a case ends fatally, he must be fed frequently and liberally. These patients rarely refuse food, but require careful coaxing and feeding; and a skilful attendant will give something every two or three hours—minced meat and vegetables, or bread and milk, beef-tea, eggs, and the like. Brandy often produces great excitement at the onset and height of an attack, and stout or ale is more suitable, and more likely to bring about sleep. We may give also plenty of lemonade, barley-water, and such drinks, if there be great heat and thirst.

Although this unconscious or semi-conscious delirium may continue for many days, yet in almost every case the violence and excitement are paroxysmal, with intervals of comparative calm, even if there be no sleep. Judicious attendants will avail themselves of these quiet intervals to administer food, and to keep the patient in the recumbent posture, thus ensuring rest, instead of letting him be continually on his legs wandering about the room, and so exhausting his strength. And when held down in this way, with cold cloths applied to the head, or his face fanned by the nurse, he is not unlikely to drop off to sleep.

Can sleep be procured by other means? The French have advocated prolonged hot baths, but they are attended with considerable danger. We may try a bath of half-an-hour at 90° or 92°, allowing it to become cooler, but it is of no use attempting this unless the patient submits to it without a desperate struggle. Cold to the head may be applied, because it is soothing and grateful to the sufferer, though it is a question whether the circulation in the brain is much affected thereby.

The bowels may be kept open by a few grains of calomel administered in the food, or half-a-grain of podophyllin. Active purgation is inadmissible except at the very outset, and enemata cannot easily be given in the violent stages. It is somewhat the fashion to apply blisters to the nape or calves. This is most inadvisable, for such parts may become very sore, owing to the restlessness of the patient, and thus deprive him of sleep. Neither is it necessary to cut all the hair off, which in the case of a lady may be a very grievous matter. If very long, it may be shortened without being cut close to the head.

**II. Acute Mania.**—Quite different from the unconscious raving of maniacal delirium is the conscious but violent excitement to which we give the name of *acute mania*. The former is a disorder dangerous to life, running a rapid course to death or amendment in a week or two. The latter may go on for weeks or months with little danger to life, but with excitement so troublesome that the sufferers require the restraint and discipline of an asylum. Though most insane, full of delusions and insane habits of every kind, they know what they are about, and are all the more mischievous in consequence. They can take every advantage of an opportunity, and know how to exasperate those about them. They generally eat well, and sleep indifferently, but sufficiently to support life; and their bodily health often remains wonderfully good considering what they go through. They will destroy clothes, windows, bedding, and deny or justify all they have done. The termination is not usually fatal, unless the health gives way through some other disease. The patients generally recover gradually, or sink into chronic mania or dementia.

Prognosis.—The prognosis in cases of acute mania will depend upon circumstances. (1) The number and duration of the attacks are important. In a first attack the prognosis is favourable. If recent, we may have hopes, even if there have been preceding attacks of a like character. (2) If the patient is not of advanced age or of broken health, the prognosis is favourable. (3) If the mania consists of violent, turbulent conduct rather than of fixed delusions, as is frequently the case, there is more hope. If the patient hears voices, the prognosis is bad. If there are delusions which impel him to refuse food, and he does so persistently and violently, it may be difficult to give sufficient nourishment, and he may sink from exhaustion, or become a chronic maniac.

Treatment. — Patients suffering from this form of mania do not require, like the last, to be kept in one room; on the contrary, they should take plenty of exercise in the open air. This will promote sleep more than drugs, though we may give an occasional dose of chloral, or bromide of potassium, or the latter with chloral or with Indian hemp. Such medicines, however, should be given only to procure sleep, not to allay excitement. Plenty of food is required, for the waste is great.

Such patients are not to be cured or even kept without discipline and moral treatment; and great tact, firmness, and patience are required for their management. They may be very dangerous and spiteful, will know how to provoke attendants, and how to take them unawares if off their guard. Such moral treatment will be far more efficacious than drugs, but it can only be carried out in an asylum. Patients in this condition, if kept in private houses, must be rendered quiet by drugs; but there is great fear lest by this the disease, instead of being cured, may be converted into a chronic and incurable mania.

**III. Mania.**—A great variety of cases are grouped under this name, arising from various causes, but alike in the fact that they are marked by excitement rather than depression, by exaltation or wrath, but not by gloom. Excitement, and noisy and irrational conduct, characterise

some, but most patients present delusions coinciding with their temper and bodily condition. Almost always this form of insanity is marked by delusions, if it lasts long enough; but sometimes a short burst of excitement—a transitory mania—may pass away without the stage of delusion being reached.

The diagnosis of an ordinary case of mania is not difficult. The prognosis must depend on the cause; the age of the patient; the character of the delusions, if there be any; the occurrence or non-occurrence of previous attacks; and their history. Attacks of mania are frequently recurrent, and may recur again and again through a long life; recovery may take place on each occasion, or the disorder may at last turn into chronic mania or dementia. The period of excitement in many cases is followed by one of depression, and these may alternate with great regularity for twenty or thirty years; and even when the patient is sunk into hopeless dementia, the period of excitement may occur as regularly as before the mental powers had given way.

TREATMENT.—Of the treatment of these cases little can be said. The majority will need the care of an asylum, at any rate during the excited stage. The intervening or rational period will often be prolonged by removal from the asylum, and when this is the case there is frequently less reluctance to return to it when the necessity arises, and instances are not uncommon of patients themselves seeking its shelter.

G. F. BLANDFORD.

**MANIPULATION** (*manus*, the hand).—A mode of investigating and also of treating diseases by the use of the hands. *See* PHYSICAL EXAMINATION; FRICTION; and SHAMPOOING.

**MARASMUS** (*μαραίνω*, I grow lean).—A synonym for general wasting. *See* ATROPHY, GENERAL.

**MARIENBAD**, in Bohemia.—Alkaline sulphated waters. *See* MINERAL WATERS.

**MARSH FEVER.**—A synonym for intermittent fever. *See* INTERMITTENT FEVER.

**MASKED.** A synonym for larvated. *See* LARVATED.

**MASSAGE** (French).—A synonym for shampooing. *See* SHAMPOOING.

**MASTALGIA**
**MASTODYNIA** } (*μαστὸς*, the breast, and *ἄλγος*, or *ὀδύνη*, pain).—Pain in the mammary gland. *See* BREAST, Diseases of.

**MASTICATION, Disorders of.**—In the mouth the food is submitted to the action of the jaws, carrying the teeth; is moved about by the tongue; and is kept between the teeth by the lips, cheeks, and tongue. The muscles which perform the complicated and nicely-adjusted movements of mastication, are supplied by the trifacial, facial, and hypoglossal nerves—that is, the v., vii., and xii. pairs of cranial nerves respectively. These movements are essentially voluntary, the stimuli which determine them being central in origin, and passing to the muscles by the above-mentioned nerves; but at the same time, the mere contact of the buccal mucous membrane with food, aids in determining the movements, its impressions travelling to the brain by the fifth pair of nerves.

Mastication is liable to be disordered from various causes.

1. *Muscular Paralysis.*—Imperfect performance of mastication is frequently the result of cerebral lesions, such as hæmorrhage or tumours. Dependent on the seat and extent of these will be the extent of the paralysis, which may vary from an impaired movement of one cheek, thus permitting the food to collect between it and the gum, to an absolute loss of power of swallowing. Sometimes the purely reflex portion of this act may be retained, mastication being impossible; or it may be that the tongue alone is affected, from injury to the nucleus of origin of the hypoglossal nerve. In those cases where the trifacial alone is affected, mastication is rendered difficult, by the absence of the contact-sensations which aid in determining normal movements.

There are several special forms of paralysis in which these movements are affected, either alone or in common with other muscles of the body.

(*a*) *Labio-glosso-laryngeal paralysis*, due to certain morbid conditions of the medulla, affecting the glosso-pharyngeal, hypoglossal, and spinal accessory nerves, is especially characterised by the impairment of mastication and deglutition, which progresses from a mere escape of saliva, due to paralysis of the orbicularis oris, to absolute inability to perform either act. Of the masticatory muscles, it is those of the tongue and cheek which are mainly affected, the elevators and depressors of the jaw usually escaping. The patient thrusts his food to the very back of the mouth; and even then, when in the grasp of the constrictors of the pharynx, it is swallowed with difficulty; often being ejected through the nose, or getting into the trachea through the imperfectly closed glottis. As the disease progresses to its invariably fatal end, the palsy increases in completeness.

(*b*) The loss of power in the muscles of mastication and deglutition, so frequently associated with *diphtheria*, is doubtless dependent on some central changes, since it is only one of the many forms of paralysis that may complicate this disease. At the same time it has been in part ascribed to degeneration of the muscular tissue.

2. *Muscular Spasm.*—Trismus, or tonic spasm of the muscles of mastication supplied by the motor branch of the fifth nerve, is rarely unilateral. The jaws are usually completely locked, and incapable of separation, thus rendering mastication impossible. The trismus may be a part of a general condition of tetanus, or may be the sole indication of spasm; and in the latter case is usually reflex in origin, being determined by such causes as dental irritation, or facial neuralgia, or, more rarely, by distant wounds or intestinal worms.

Irregular clonic spasms of the muscles of the jaws, such as are frequently seen in epilepsy and hysteria, and are evidenced by chattering and grinding of the teeth, will offer some difficulty to the proper performance of mastication.

Spasm, whether tonic or clonic, when limited

to the facial muscles supplied by the seventh pair, will interfere but slightly with mastication. By preventing the action of the lips and cheeks, the food will not be so easily kept between the teeth, and the saliva will dribble from the unclosed mouth. Nor are the impulsive spasmodic movements of the tongue, as seen in chorea, important as impairing the proper mastication and swallowing of the food.

3. *Affections of the Temporo-maxillary Articulation.*—Chronic arthritis may lead to such serious disorganisation of the joint as to impair its movements, anchylosis occasionally occurring.

4. *Tumours.*—Enlargements of the salivary or lymphatic glands, tumours of the thyroid body, epulis, and new growths of the tongue, may interfere with mastication.

5. *Morbid Conditions of the Mouth.*—Inflammation of the mouth or tongue, and disorders of the teeth, render mastication difficult.

The several subjects here referred to are treated of under separate headings.

Effects.—Portions of food imperfectly masticated may produce suffocation, by blocking up the entrance of the glottis, or lodging in the gullet. Imperfectly masticated food, when swallowed, is a well-recognised cause of dyspepsia and its many inconveniences.

Treatment.—The treatment of disorders of mastication naturally consists in the removal of their cause, when possible. The reader is referred to the articles in which the several conditions are fully discussed. W. H. Allchin.

**MASTURBATION** (*manus*, the hand, and *stupro*, I ravish).—Synon.: Fr. *Masturbation*; Ger. *Selbstbefleckung*.

Definition.—The production of the sexual orgasm by unnatural means.

Ætiology.—This practice is found to occur under a variety of circumstances. First, in very young children, local irritation, situated beneath the prepuce in males, or within the vulva in females, leads to manipulation of the parts, and to consequent pleasurable excitement, which is constantly renewed, with an entire unconsciousness of the meaning of the practice. As an instance, not long since the writer was consulted by a mother about the extreme delicacy of her boy, then little over four years of age. No tangible disease being evident, the little fellow was stripped, with the view to a more complete examination. Whilst this was being made, the child was seen to rub his penis with the hand in the most careless manner, causing thereby an erection—an observation which explained the cause of the ill-health.

The second class includes cases which are of a very different character. The individuals in this class have reached or are near the age of puberty, and have either accidentally learned, or been taught, this pernicious habit. *Pruritus vulvæ*, due to diabetes or other causes, may, for instance, lead to it in the female. A third class of cases may be mentioned, in which the practice has a central origin, in certain forms of brain-disease or cerebral deficiency, as is seen in some forms of insanity and in idiocy.

In the last two classes of cases it may be said that there is often more or less perversion or loss of the higher moral feelings, if not entire degradation of the moral sense.

Effects and Symptoms.—There is no doubt that the excitement incident to the habitual and frequent indulgence in the unnatural practice of masturbation leads to the most serious constitutional effects. These effects are more especially manifested in the nervous system, the functions of which are perverted. The mental faculties become more or less affected; and often great despondency, loss of memory, irritability, prostration of strength, headache, and neuralgic pains ensue. Anæmia occurs, and the functions of the heart and other organs of circulation are disturbed. Digestion is disordered. There is general loss of health and strength; and chronic hypochondriacal invalidism, if not worse, is set up. In certain cases the urinary organs are affected; and the writer has observed in several instances the presence of albumin in the urine, which would seem to be the result of some reflex action on the nerves and vessels of the kidney. The effects on the male genital organs themselves are marked. There is extreme irritability of the neck of the bladder and adjoining parts, accompanied by discharge of mucus and of prostatic secretion, often mistaken for semen. At the same time seminal emissions are prone to occur on the least sexual excitement, either by day or during sleep; and in extreme cases there is impotence. In the female the natural feelings are often lost.

Diagnosis.—In many cases of masturbation in young men the diagnosis is sufficiently easy; for such persons, alarmed by reading the advertisements and books written specially to excite feelings of shame and fear, and to bring the subjects of them within the nets spread abroad by quacks, are sufficiently ready to declare the cause of their distress. In other cases, in which the practice is concealed from fear of the consequences, or from innocent unconsciousness of its nature—and this is more especially the case in females, the diagnosis is often very difficult. When, however, the symptoms just described are present, in the absence of any cause to account for them, the practitioner may entertain a reasonable suspicion of the existence of this habit, although it may be difficult in many cases to carry his impression beyond the suspicion.

Treatment.—In the first class of cases above mentioned—that is, in very young persons, in whom some local irritation exists—the source of this irritation must be found and removed. Sometimes it may be an elongated prepuce, with irritating matter beneath it; in such cases circumcision may be required. In females cleanliness and simple lotions may suffice; or irritation caused by the wandering of thread-worms or otherwise may require to be treated. In these cases attention to the general health, to the state of the digestion, to the urinary secretion, and to the bowels should not be neglected. Diabetes must be searched for, and treated if present. Extreme watchfulness by the nurse is necessary, and at night it may be even necessary to secure the hands by muffling or tying them behind the back.

In young adults the moral sense must be

acted upon. It has been suggested, by way of prevention, that judicious and kind advice may with advantage be given before even a knowledge of the habit is acquired, whilst too much vigilance cannot be exercised by those who direct and assist in the management of schools.

In the actual treatment of the disease, that is, the effects established by masturbation, it is of the highest importance to improve the health, both mentally and bodily. Early rising and healthful exercise, with careful diet, and travel, if practicable, should be recommended. Remedies directed to the treatment of symptoms connected with the nervous, circulatory, and digestive systems will be required. Of course the habit must be entirely surrendered, and all thoughts of a loose or libidinous character must be avoided. The bromides, especially the bromides of potassium and ammonium, are very useful for lessening sexual excitability; and in the case of females, these may be more especially needed at the close of or just after the catamenial periods. In certain cases where these remedies, together with steel, and other appropriate drugs, have failed to diminish the frequency of the seminal emissions which are common in males, caustics may be applied to the neck of the bladder. *See* SPERMATORRHŒA.

**MAW-WORMS.**—A synonym for thread-worms. *See* THREAD-WORMS.

**MEASLE.**—In helminthology this term is frequently employed as a synonym of *cysticercus*. Thus, we have pork, beef, and mutton measles, each entozoon being a distinct form of bladder-worm, and therefore, at the same time, the larval representative of an equally distinct species of tape-worm. The human measle is a variety only of the pork measle, both forms constituting what is sometimes called the scolex-condition of the *Tænia solium*. Most kinds of flesh ordinarily consumed as food are liable to become 'measled,' but no such parasites have hitherto been detected in the muscles of the horse. This fact supplies an argument in favour of hippophagy. For detailed information respecting all the known forms of human and animal measles and bladder-worms the reader is referred to Dr. R. Moniez' *Essai Monographique sur les Cysticerques*, forming the first part of the third volume of the *Travaux de l'Institut Zoologique de Lille*, 1880. *See* BLADDER-WORMS; and CYSTICERCUS.

T. S. COBBOLD.

**MEASLES.**—SYNON.: *Morbilli*; *Rubeola*; Fr. *Rougeole*; Ger. *Masern.*

DEFINITION.—An infectious specific fever; with an eruption, on the fourth day after catarrhal symptoms, of a deep-red spotted rash; this is at first slightly raised, and is distributed in crescentic groups, which soon extend over all parts of the surface; it persists as a general mottling after the subsidence of the fever, and where intense may cause a fine desquamation. The disease prevails as an epidemic; and it very rarely, if ever, attacks the same person more than once.

ÆTIOLOGY.—Contagion is the cause of measles wherever it is now met with. In large towns, where sources of infection always exist, epidemics recur about every four years, chiefly among children, as fresh series of the susceptible become exposed. Few adults suffer; most of them having been attacked in childhood. Among scattered populations long periods may elapse without infection reaching them; when it does, neither age nor sex influences directly either the liability to attacks, or their severity.

The essential characters of the disease are everywhere the same. The fatality is increased by extremes of heat in hot countries and seasons and by extremes of cold in cold climates; by malarial soil, vitiated air, or crowded dwellings; by defective diet; and by scurvy.

The annual mortality from measles in London is nearly five per ten thousand. The deaths from measles are about one per cent. of all deaths in England and Wales, and nearly two per cent. in large towns; this is higher during epidemics, but has not reached much beyond 2·7 in London. The proportion of deaths to attacks varies from twenty to thirty per cent. in crowded wards, to one or two per cent. in healthy houses; the mortality of ten or twelve per cent. is a common estimate.

The contagium of measles, except in the catarrhal stage, is not far diffusible in the air, but clings to surfaces, and may so be carried from place to place. Children with full eruption have been brought into a house among others, and nursed in a room apart, without any extension of the disease even to the most susceptible. When young infants are said to escape infection, it is where the family is small, and they are less exposed. Among young children the deaths are in equal proportion to the numbers of the two sexes living. With us more than half of the whole number of deaths from measles are of children under two years of age; the proportion thence progressively diminishes. This differs from what is observed in scarlet fever and diphtheria; moreover, the proportionate fatality of these latter diseases in the two sexes is greater for girls.

Measles in a school or family is sure to spread; the catarrhal stage, infectious throughout, is mistaken for a common cold, and no timely separation is attempted. The cough is an important means of conveying infection at this time. The period of incubation is ten to twelve days, rarely a day or two more. During the latent stage of this long incubation, those who have been exposed to infection are thought to have escaped, and are sent to begin the same round elsewhere. The disease may be conveyed by *fomites*. Infection begins before the rash appears, and the contagium may be given off by the third day, most probably during the greater part of the incubation-period. The contagium principle developed only in the bodies of the sick, is found during the height of the disease in the tissues, the secretions, the blood, and the breath. Inoculation at this stage either with the blood or serum, by Home, Cullen, and others, reproduced measles without modification; the primary fever then appearing on the seventh day, and the eruption on the ninth and tenth. Mayr, of Leipzig, twice conveyed the disease by means of nasal mucus. Catarrh began on the eighth and ninth days; rash on the tenth and eleventh. After an attack

of measles personal infection is probably over by the end of a month; it may persist longer, or be conveyed somehow by convalescents for another month. How long infection may cling to articles of clothing, or linger in closed rooms, is uncertain. After two years of age the mortality is not greater in proportion to the number of attacks than at other periods of life; and there is some advantage in contracting this disease at a time when careful nursing and individual attention can be secured. Those who escape measles during childhood are very likely to be seized on taking their part in mixed communities.

Pathology.—Measles is the type of a zymotic disease. An organised ferment, *bacterium* or *torula*, in a suitable medium, at first increases slowly, with barely noticeable changes; then comes a more violent disturbance; after which the zymotic organism ceases to develop, and the medium can no more sustain a similar action. After experimental zymosis the fluid medium clears, and the organisms accumulate at some part of the containing vessel. Several years ago Dr. Ransome, of Manchester, obtained particles from the breath of two persons suffering from measles. Drs. Braidwood and Vacher have since confirmed this observation. Glycerine, on which children with measles respired during any of the eruptive days, exhibited numerous highly refractile bodies, larger than those seen in vaccine-lymph; others were elongated, with sharp-cut ends, sparkling and colourless; they were most abundant in the two days of greatest eruption; they were not found in the breath during health, nor in the course of scarlet fever and typhus. After death from measles, on the eighth day, they were found in the true skin in groups below the rete mucosum, by the lymph-spaces and sweat-ducts, but not deeper than the level of these glands; sparkling, spindle-shaped, rod-like, or canoe-shaped bodies were also seen, which did not take the carmine tinge. These bodies were not seen in the lymph-spaces, nor in the sweat-ducts and glands, nor in the hair-follicles. In the lung both forms were found in some exudation filling the alveoli. The spherical forms have a dark, smooth outline, and do not readily take the carmine stain. Near these were rod-like, fusiform, or ovate bodies, slightly tinged with carmine. These are quite distinguishable from the particles seen in other forms of pneumonia. With a high power, similar sparkling, staff-shaped bodies were seen scattered round the bile-ducts. None were found in the kidneys, spleen, or mesenteric glands.

In the blood some increase of white and a great decrease of red corpuscles occur during the fever. Numerous moving microzymes have been seen during the eruption, decreasing rapidly, and disappearing in three weeks; but temporarily reappearing with any febrile disturbance.

Anatomical Characters.—The mucous membrane of the larynx and trachea is always red in measles, often with punctiform congeries of vessels; and not unfrequently thin films of lymph are found loosely adherent. The bronchi are congested, sometimes with exudation on the lining membrane, more frequently covered with mucopus, or plugged with catarrhal mucus; capillary bronchitis with broncho-pneumonia is frequent. Lobules of the lung are often collapsed or inflamed; the pneumonic exudation, whether the result of occluded bronchioles, or of direct congestion, fills or breaks down the alveoli, and invades the parenchyma. Lobar pneumonia, if extending to the surface, is accompanied by pleurisy, often limited to the part of the lung affected. Fluid may be found effused into the pleura or pericardium, without any traces of inflammation. Petechiæ are often found on the pleural surfaces. Any inflammatory signs, either cardiac or articular, in the serous membranes are so rare as to be quite exceptional. Dark, soft coagula are found in the right side of the heart, in the venæ cavæ, and in the cranial venous sinuses. The meninges are congested; there is injection and hyperæmia of the brain-substance, and increased fluid in the ventricles and subarachnoid space; more rarely recent lymph is seen on the surface of the hemispheres; deposits at the base belong to later consequences of the disease. Congestion of the digestive tract is most marked near the ileum and colon; externally the distended veins of the submucous coat are seen; internally there is deep redness of the surface, the solitary glands are distended and elevated, the agminated to a less degree, but there is little or no enlargement of the mesenteric glands; the follicles of Lieberkühn and the tubular glands of the large intestine are more distinct than usual; a chronic ileo-colitis may result. The liver is mottled; both the portal and hepatic veins are full; and the lobules are ill-defined and granular in appearance, with fatty particles interspersed. The bronchial glands are often enlarged, and sometimes softened; suppuration from them extended up behind the œsophagus in one instance. The lymphatic glands of the neck are always congested and enlarged, and often those elsewhere, as in the axilla or groin. The spleen is swollen and friable, or very little altered. The kidneys show no distinctive changes; they are hyperæmic in the earlier stages of the disease, and the tubules may then be full of epithelium and cell-débris; the degree of after-congestion depends much on the degree of pulmonary obstruction, or on early exposure to cold or fatigue; no albumen or casts of renal tubes are found in the urine, unless a secondary nephritis have been thus occasioned.

Symptoms.—The symptoms of measles seldom occur until eight days after exposure to infection. They may begin suddenly, with high fever, aching pains, and vomiting, the initial fever subsiding next day, but not completely, when there may be little feeling of illness, but some signs of coryza, cough and sneezing, with enlargement of the lymphatic glands in the neck. On the third day the coryza is more marked, the cough often very troublesome, and the fever increased. Some few spots of eruption are now visible on the forehead and sides of the face. The conjunctivæ are injected, the tonsils full and smooth, the soft palate mottled, the tongue furred, the pulse quickened. On the fourth day the eruption appears more fully, with rapid pulse and sudden elevation of temperature, often to 104° by night, with delirium. On the fifth day, with full rash, there is marked alleviation of all the symptoms: the cough is quiet; the pulse is less full and fre-

quent; the tongue cleans; and the temperature, already fallen by 3° or even 4°, often reaches the normal by the sixth day, leaving the skin still deeply stained by the fading rash, and the patient weak. During the next week or ten days there is a tendency, not only to depression, but to sudden rises of temperature, with various complications that retard or endanger convalescence. We notice three stages:—the *ingress*; the *eruption*, and the *decline*.

*The ingress.*—The ingress of measles is not always with marked initial fever. Coryza and spots of the rash may be observed before illness is complained of, though some elevation of temperature can be traced by the thermometer for three days before the full eruption. This febrile movement has been preceded in some cases, where thermometric observations were made throughout the period of incubation, by a well-marked depression of short duration. Before this, fatigue, headache, vertigo, chorea, and other irregular symptoms may occur. Often some slight disturbances of health, and even cough, have been observed all through the incubation-period; sometimes an intercurrent disease has delayed the regular march of the invasion to seven or eight days, or the latent stage has been prolonged to ten or twelve days; more frequently this is reduced to three days, and even these days may be febrile from a concurrent influenza or herpetic catarrh. The eruptive fever always occupies four days. As this approaches the crisis, many symptoms are aggravated. Incessant cough occurs, often in children with croup of the catarrhal kind; bronchial irritation with *râles* and rhonchal fremitus, or possibly submucous rhonchus, may be heard at the pulmonary bases; the respirations, hurried and shallow, are 30 to 40 in the minute; the pulse is quickened to 130 or 140. Both the respiration and the pulse, especially the former, are more accelerated in young children; and with them convulsions may at this period retard the eruption or prove fatal. Death before the rash is thrown out, though rare, has also happened in adults. The urine is scanty, yellow or dark-coloured, and deposits lithates; in extreme cases it has been suppressed. Abdominal pain or diarrhœa may occur, and the latter may become a serious symptom. Thirst is great; the lips are dry; the tongue is moist, with red papillæ showing through a thick white fur; the palate and fauces are red, from many punctiform congeries of vessels; the deep injection and swelling of the pharynx may extend to the Eustachian orifices, and cause deafness; deglutition is painful, and sometimes difficult, from the imperfect closing of the turgid epiglottis, as well as from fulness of the tonsils. With these throat-symptoms the gland at the angle of the jaw is somewhat enlarged and tender; but there is not much swelling or œdema of the overlying integument. The lymphatic glands of the neck are palpably enlarged before there is much or any rash on the skin, those of the axilla and groin afterwards. Epistaxis is not rare. The eyelids are swollen, the conjunctiva being inflamed and purulent; there is intolerance of light; there is fear of the eye being permanently injured. The nocturnal delirium and most of the other symptoms abate when the eruption is complete.

*The rash.*—The rash first shows itself in distinct, red, and nearly circular spots, much scattered; fresh spots soon show in the clear skin They begin as red points, which are raised, and feel rough or 'shotty,' especially on the face, and early in the eruption; they then form crescentic groups, which coalesce into patches of irregular outline on the body. The face, disfigured by the swelling, is first covered; then the neck and chest. The rash is also well-marked in the scapular region, extending to the rest of the trunk and to the extremities on the second day, becoming more sparse as it descends. A peculiar and offensive odour from the sick is recognisable during the whole eruptive period. The rash declines in the order of its invasion. Within twenty-four hours the swelling of the face subsides; the red spots, no longer raised, become pale under pressure, and leave a yellowish discolouration, or on the shoulders marks of a dusky red. Considerable irritation attends the rash, continuing with it to the third day or longer. At this time fine desquamation is noticed on the face; small scales of cuticle are detached from the top of the enlarged papillæ, so that most of the surface is furfuraceous; this disappears with the irritation by the second week, or may persist a week longer; it does not occur when the eruption has been slight, hardly ever on the fingers and feet, and never in large shreds. A coppery, mottled discolouration remains on the more vascular parts of the skin, or where the rash has been most marked, for eight or ten days, and sometimes continues visible three weeks from the commencement of the illness. The eruption may begin on other parts of the body than the face, as at the seat of any injury to the skin. The disease may run its course safely with very little, possibly without any eruption. An imperfectly developed dusky or livid rash is met with in severe cases. With serious lung-complication a full rash may recede. Petechial specks may accompany a moderate eruption, or hæmorrhagic spots complicate the irregular forms. Some of the earlier spots may not only be raised and acuminate, but minutely vesicular at their apices. In the dark races the eruption is yellowish, raised above, but somewhat lighter in colour than the surrounding integument; in the mulatto it varies from a yellowish to a dusky brown; but all other signs of the eruptive period are well marked.

*The decline. Complications and sequelæ.*—The pulmonary lesions of the febrile stage, capillary bronchitis or broncho-pneumonia, may delay defervescence, or rapidly prove fatal. With moderate lung-mischief the fall of temperature following the rash is often very marked, and, with extreme depression further congestion of the lung will occur. The liability to depression of temperature which follows many acute fevers, is specially marked in this one, and requires to be guarded against. A tendency to sudden elevations of temperature is also noticeable for ten or twelve days after the eruptive fever subsides; rarely this has been accompanied by a recrudescence and reappearance of the rash, sometimes by no definite changes, possibly by some that are obscure, of the nervous centres. The common accidents of this period are—first, a return of cough in children; this may be croupy, beginning

the very day of the first decline of temperature. The temperature again rises suddenly, perhaps to 103°, with greatly excited pulse and respiration. Next day there is tracheal rhonchus, but no increased size of the cervical glands. The cough then becomes looser, and thin shreds of false membrane are expelled. This form of membranous croup is as common from three to six days after the rash, as catarrhal croup is the day before the rash. It rarely attacks more than one child in a family; this is sometimes the same child who had laryngeal symptoms in the catarrhal period. In some epidemics laryngitis and subsequent hoarseness have often followed. More frequently a return of cough indicates the commencement of bronchitis or of broncho-pneumonia. In the latter a sharp elevation of the temperature of no long duration occurs. Lobar pneumonia, less frequent, maintains a higher range of temperature; it may be mistaken for meningitis. Pleurisy, except in connection with lobar pneumonia, is rare. Otitis may cause a high temperature of short duration. Three or four such interruptions may happen in a single convalescence. Serious complications, not attended with much temperature-disturbance, are found in diarrhœa, dysentery, and passive hæmorrhages. Enteritis, with diarrhœa and dysentery, is as fatal and frequent a complication of this disease in hot climates as are pulmonary affections with us. In convalescence, after a critical increase of urine, the kidneys act more freely; if during pulmonary obstruction the chlorides were diminished, they now reappear, the excretion of urea is increased, and uric acid may be eliminated in excess. Albuminuria, unless determined by extreme neglect and exposure, is not a consequence of measles.

Impairment of health results as often from this as from other specific fevers. Nerve-waste may lead to imbecility and dementia. Acute tuberculosis is started, or tubercular deposits begin after measles. The strumous diathesis is evoked, and may set up a troublesome ophthalmia, with danger to the cornea; or a fatal ulcerative stomatitis. Abrasions of the nares or lips may persist or extend, eczema or ecthyma appear, and glandular enlargements increase or become chronic. Even in the robust acute pulmonary disease is readily induced by exposure or want of care during convalescence; a liability to this, to pustular eruptions, and to irregular febrile disturbance, may persist for three weeks. It has happened that some nervous disorders, such as chorea or mania, have been arrested during an attack of measles, even with permanent benefit. Measles not infrequently co-exists with mumps and with whooping-cough, more rarely with varicella and vaccinia. Either of these, taken with measles, is delayed or interrupted, resuming its course when the eruption of measles is over. Whooping-cough, established beforehand, is temporarily interrupted by an attack of measles. Scarlet fever may complicate measles, also erysipelas; or measles may be contracted in the course of typhoid fever. Diphtheria is not so frequent a complication of measles as it is of scarlet fever. After any of these diseases the liability to suffer infection from the others seems to be increased. The exemption from a second attack of measles is not universal, but the exceptions to the rule are so few as to be rarely observed. In two instances observed by the writer, at intervals of fifteen and twenty-five years respectively from the primary attack, the rash was preceded by the usual catarrhal fever, and was but slightly, if at all, modified. Out of numberless mistaken cases, no other has come under his notice. An allied form of rubeola (*sine catarrho*), essentially distinct, is commonly mistaken for measles; hence the belief in second measles.

Diagnosis.—The first spots of measles, if scattered, raised, and hard, may be mistaken for those of small-pox; or the small-pox eruption may begin with some measles-like roseola. The temperature curve for the two diseases is similar. In the small-pox curve a sudden rise begins only two days before the eruption, whilst in measles there is a gradual rise for three or four days; this in small-pox is evidenced by a history of sudden and severe illness only on the day but one before the eruption, whilst in measles there is no such symptom on that day, the illness dating from a day or two earlier, usually with distinctive catarrhal symptoms.

The declining rash of measles leaves a mottling of the skin, not unlike the mulberry eruption of typhus; the latter seldom appears before the fifth day of the disease, the fever continuing high for several days after. In measles, at this stage of the rash, the fever has already begun to decline, the temperature falling suddenly, often to below the normal. The rash of *rubeola sine catarrho*, *Rötheln*, or *rubella*, closely resembles the eruption of measles; the spots, brighter in colour and even more discrete, are preceded by only one day of headache or slight sore-throat. The incubation-period generally is longer than in measles. In scarlet fever the ingress is sudden; there is the characteristic sore-throat; and there is the early appearance on many parts of the body of the finely diffused, comparatively smooth, bright scarlet redness of the rash. The incubation-period has been short. In erysipelas the redness appears at one part only, and extends from that, whether it be the face or other parts of the body. Roseola from irritating articles of food has very little fever, and no enlargement of the cervical glands, otherwise it might look like measles. Urticaria and erythema, with differing aspect, cause but slight thermometric disturbance.

Prognosis.—This is mostly favourable in measles; the tendency of the febrile action is to recovery. Favourable progress may be endangered by—1. The bad health of the sufferer. 2. Want of care. 3. Insanitary surroundings. Under either of these conditions the simplest kind of measles in a healthy subject may give rise to the worst forms of the disease. Morbilli *mitiores* and *graviores* are not essentially distinct. High fever with the eruption is not in itself unfavourable; at this time a temperature of 105° in children, and 104° in adults, or half a degree beyond, is safely reached; with precautions at its sudden decline, the progress afterwards is most satisfactory. High temperature during the after-course is a sign of greater import; it guides to various complications, and subsides as they are relieved; occurring irregularly it is a cause for anxiety; if steadily maintained, or recurring regularly at short intervals, with wasting as a

result, there is little hope of recovery, and none if acute tuberculosis of lung or of brain is evidenced. The latter danger makes convulsions of worse augury in the decline than during the ingress of measles in young children; convulsions, taking the place of delirium in older persons, cease after the eruption. Recession of the rash is not alarming when the attack is slight, or the temperature is low at the crisis; when there is pulmonary or other local congestion, and at the same time sudden depression, it becomes an additional sign of danger. A dark rash, interspersed with fine red specks, may occur early in cases of moderate severity; a dusky or livid colour subsequently marks cases of considerable intensity; petechial or hæmorrhagic blotches at this time are of grave import, as indicative of scorbutus, which state ranks next to impaired nutrition in infants, as the most unfavourable concomitant of measles. Black or hæmorrhagic measles, without scorbutus, is more rare than is hæmorrhagic or black small-pox. Some dangerous hæmorrhages may follow measles where no scorbutic condition exists. Among insanitary conditions, though the presence of sewer-gas has in isolated instances determined a fatal result, the most disastrous is overcrowding. The great mortality from measles is due to lung-disease, not at the height of the fever, but in the second week; the frequency and severity of pulmonary complications being less a direct effect of low temperature than of tainted air in which the poor are pent up for the sake of warmth. During the ingress of measles exposure to cold may occasion a highly dangerous suffocative catarrh, with capillary bronchitis; after or during the rash a chill is as likely to conduce to serious diarrhœa as to pulmonary congestion, especially in hot weather. Equally depressing in their effects, these are direct results of the disease independently of weather or season. Measles contracted during acute or prolonged illness is a grave addition to the danger. In the puerperal state infinitely less mischief is produced by this disease than by scarlet fever; delivery has been hastened without mischance, or abortion has resulted, not without risk of fatal results; there are times when young married women who have not had measles should keep from risk of infection. It would seem that the child can go through the disease *in utero*, with after-immunity. There is an instance on record of a mother with measles giving birth to a child 'full of measles,' both doing well; others of infants having the rash three, five, and eight days after birth, when the mother was herself ill. Infants escape measles while suckling, insomuch as they are less exposed to infection; they suffer no less severely than others. In adolescence a body-heat of 107° has been safely passed, during the decline of measles, with no marked complication. In children of all ages a warning is given of some danger closely following the eruption, when the normal fall of temperature at the crisis is delayed or prevented. In advanced convalescence sudden rise of temperature, with delirium, often marks an attack of pneumonia; this, if of limited extent, may be hoped to end favourably in a week by resolution, without much cough, but with steady high temperature till near the end.

Treatment.—Rest, pure air, equable warmth, diluents, and nourishment, are the chief requisites in the treatment of measles.

All risks from exposure or fatigue should be avoided while the disease may be only latent. The first catarrhal signs demand confinement to the room; the initial fever, rest in bed. The usual meals, moderate in quantity, can be taken; if not, milk, broth, or meat-jelly will be required. Extra liquids, as barley-water, lemonade, or even cold water, and small pieces of ice, are pleasant and necessary. Simple salines, as potash in the lemonade, or citrate of ammonia, are useful; dilute acetate of ammonia, coloured with syrupus croci, is an old and good form; to this a few drops of ipecacuanha wine may be added, but neither expectorants nor diaphoretics have any influence on the cough until after the eruption. The bowels must be gently regulated; a furred tongue is not a reason for giving purgative medicine. No diminution of the expected critical fever, if this were desirable, will be brought about by the action of emetics and aperients; where either of such evacuations have troubled the ingress, the eruption is delayed with no after-benefit. The free use of cold, so speedy and potent an antipyretic in scarlet and other fevers, is not required in the early stages of measles, and would be injurious until after the eruption is out. In the fever of measles a certain progressive rise of temperature is necessary to its favourable termination; where this is interrupted, as by debility or chill, sometimes by convulsions in infants, the warm bath is to be used. At this stage of the disease wine is rarely necessary; it may be required after epistaxis or for sudden depression, where food has not been taken. The room should be kept quiet, and perhaps dark, so that sleep may be favoured. Tepid sponging of the surface, part at a time, relieves the feeling of heat and tension; irritation is soothed by applying cold cream to the face, and carbolated oil to the body, or by rubbing with suet in some places. The bed-clothes should not be too heavy. An attendant may be required during the night. Good ventilation admits fresh air without draught or chill to the patient. A spray of ozonised water or aromatic vinegar freshens the air of the room. In this way, with previous good health, the danger of pulmonary complications is lessened. When several cases have to be treated in a ward, each patient should have a space screened off from draughts, and kept sweet. Directly the rash is out, the fever falls, the tongue cleans, the appetite returns, and the patient seems cheerful and well; ordinary food can again be taken, sleep returns, and no alcoholic stimulant is required. On the other hand, with dislike of food, languor, or restlessness at nights, stimulants should be given, before the dry tongue, small and rapid pulse, receding rash, or signs of pulmonary congestion, render free and frequent stimulation indispensable. There is, perhaps, no condition where wine produces such marked and immediate benefit as in the depression following upon the crisis of measles; it seems to give life, certainly it is a direct means of saving it, enabling such nourishment to be taken as will soon supply altogether the needed support. Sedatives are

not often required; a small dose of Dover's powder moderates any tendency to diarrhœa; this is always to be guarded against, and never provoked. Where, without complication, the febrile crisis is delayed, a dose of quinine with Dover's powder at night has been useful. After the crisis cold bathing, with great precaution, aids sleep, and gives tone to the cutaneous, bronchial, and pulmonary circulations; cold affusions may be necessary for hyperpyrexia at a later stage, when, if head-symptoms threaten, ice should be applied to the head. Croupy symptoms and bronchial catarrh in children after the eruption, are to be treated on general principles, as described in the articles having reference to these diseases. Diarrhœa at the close of measles may take the place of pneumonic symptoms, and need not be suddenly checked. Rest in bed, carefully regulated diet, and stimulants, with opiate epithems, or an opiate enema, will generally relieve. The mineral acids, with or without a bitter, aid digestion, and can either be given very dilute as a drink at any time, or in a definite dose with food. For the irregular febrile disturbance noticed in the weakly, they are useful adjuncts to the quinine or cod-liver oil that are then essential. Some local troubles must be treated; earache needs a dose of croton-chloral, or a warm poultice with a little opium in the ear gives relief; otorrhœa requires tepid syringing; for ophthalmia, lead lotion, and the topical use of belladonna or atropia if there be photophobia, are necessary; the swollen eyelids should be raised to see that no injury to the eye occurs while other severe symptoms may be attracting most attention. Ulcers in the mouth or elsewhere may have to be touched with nitrate of silver or boracic acid, where astringent washes are ineffective. After-treatment is always important and necessary. For the anæmia which attends convalescence some form of iron is to be taken with meals two or three times a day. Cod-liver oil should be given an hour after meals, at least twice a day, to the strumous or delicate. Often the mineral acids with a bitter are of service, especially when the rash has been livid or petechial. The clothing should be warm, with flannel next the skin. Cold bathing rapidly performed, or with salt-water, is to be recommended; and when the weather is fine the patient should go out of doors once or twice a day, avoiding chill or fatigue. Children are the better for an afternoon sleep; adults should avoid full work, or exposure at night, for one or two months after measles. Convalescents should have a change of room in the second week of the illness; means should then be taken to purify and disinfect the sick chamber, as by burning sulphur or the bisulphide of carbon in it before the cleaning; this does not interfere with other rooms in the house to which convalescents are removed. Change of air or place is not so necessary as is often supposed. Home is the best place for cure, not only until all danger of infection is passed, but that the dangers of convalescence and the possible development of any constitutional defect may be watched, and receive the earliest and best attention.

WILLIAM SQUIRE.

**MEASUREMENT.**—A method of physical examination, in which tape-measures and other instruments are used to ascertain accurately the shape, dimensions, and movements of different parts of the body. *See* PHYSICAL EXAMINATION.

**MEDIASTINUM, Diseases of.**—SYNON.: Fr. *Maladies du Médiastin*; Ger. *Krankheiten des Mediastinum.*—The principal morbid conditions which occur in connection with that region of the chest which is known as the mediastinum, are (1) aneurism of the thoracic aorta; (2) inflammation of the tissues or textures within the cavity; and (3) new growths involving the same space. Of these conditions, aortic aneurism is by far the most common; but it possesses so many special features that it will be described separately in this work (*see* AORTA, Diseases of; and THORACIC ANEURISM). The remaining pathological conditions involving the mediastinum will be discussed in the following pages.

**1. Mediastinum, Inflammation of.**—SYNON.: Mediastinitis; Fr. *Médiastinite*; Ger. *Mediastinitis.*

DEFINITION.—This term has been employed by writers to denote inflammation of the serous surface of the duplicature of the pleura separating the pleural from the mediastinal cavity, and also inflammation originating in the cellular tissue or other textures of the mediastinal space. In the former sense mediastinitis is but a variety of pleurisy, which, though it may be characterised by special symptoms, must be very difficult, if not impossible, to diagnose during life. We confine our attention here to inflammation and its results in the mediastinal cavity.

ÆTIOLOGY AND ANATOMICAL CHARACTERS.—There are very few trustworthy observations on record of simple acute inflammation of the mediastinum, terminating either in resolution or in effusion of plastic lymph. An example of the latter detailed by Wildemann is probably unique. In this instance the anterior mediastinum was filled with layers of solid exudation; the pericardium inflamed; and its cavity distended by six ounces of pus. The mediastinal effusion appeared to have been occasioned by long-continued pressure on the sternal region. On the other hand, we have numerous examples recorded, in which mediastinal abscesses have resulted both from primary or idiopathic, and from secondary or symptomatic inflammation. Primary abscess, though rare, is occasionally met with, produced either by local injury or simply cold. Gunther (in *Oesterreich. Zeitschr. f. prak. Heilk.* 1859,) and others have recorded cases of mediastinal abscess originating simply in cold. It may, however, be suspected that some forgotten physical injury had in some of these cases been received, as in the only case of the kind that has fallen under the writer's notice. Dr. Goodhart, in the *Pathological Transactions*, vol. xxviii., records a case of acute mediastinal abscess, resulting apparently from injury produced by the sticking of a piece of meat in the œsophagus But by far the most frequent cause is suppuration of the lymphatic glands in scrofulous subjects, as in a remarkable instance recorded by Dr. Bristowe, in the *Pathological Transactions*, vol. ix. p. 46. Secondary or symptomatic ab-

scesses, in the form of purulent *depôts*, are not infrequently met with in the anterior mediastinum, either in connection with operations, such as tracheotomy, or as the result of general pyæmia.

Symptoms.—The only instance of primary abscess of the anterior mediastinum that has fallen under the writer's observation presented the following symptoms:—A middle-aged lady, previously in good health, fell on going up-stairs and struck the sternum against the stone edge of the stairs. A few weeks afterwards she complained of uneasiness about the chest, and of pains in the left shoulder and about the scapula and neck. They were not severe, and had more the character of neuralgia or rheumatism than of anything more serious. After a time there was some general derangement of the health, attended by dyspeptic symptoms, a certain degree of febrile disturbance, some dyspnœa, and inability to lie down except in certain positions. Two months after the accident, which had been forgotten, there was a distinct prominence over the upper part of the sternum of an oval shape, and rather less in circumference than the palm of the hand, not red, but tender on pressure, and to which was referred a sense of uneasiness and pressure. The aspect of the patient was indicative of some anxiety, but not distress. The breathing was quiet; the pulse was quickened; but there was little or no febrile heat. There was some cough, attended by mucous expectoration sometimes streaked with blood. She complained of soreness and irritation of the larynx and fauces. The action and situation of the heart were normal. There was dulness on percussion over the whole of the prominence of the sternum, and nowhere else throughout the chest, but neither pulsation nor fluctuation could be detected in the tumour. There was no physical evidence of pressure either on the trachea or bronchi, although the patient admitted a feeling of weight or pressure, as well as of dull uneasiness; but there had been no sense of throbbing. There was no enlargement of the jugulars or superficial veins, nor any tumefaction of the base of the neck. Careful physical examination of the whole chest revealed nothing beyond a few loose mucous *râles*. Local sedative applications and the use of bromide of potassium gave some relief to the pain and local tenderness, but the cough and laryngeal irritation continued. After a few days about a teaspoonful of bright fluid blood was coughed up, and the day following a little more, without effort. The next day there was suddenly brought up from two to three ounces of purulent matter, followed by a sense of great relief. A microscopical examination of this matter revealed nothing more than pus and mucus mixed with an unusually large number of squamous epithelial cells, but not a trace of elastic tissue, or anything to indicate disorganising changes in the lung. The purulent expectoration continued, but in steadily decreasing amount, for about five weeks, the sternal swelling subsiding *pari passu*. Ultimately the sternal region was of normal aspect, and the general health was completely restored, though for some time there was occasional slight oppression of the breathing.

The above example has been recited because the symptoms correspond very closely with those which have generally characterised such cases. In some instances, however, there has been more distinct evidence of phlegmon, and a greater amount of febrile disturbance and distress. Unless the abscess be large, or associated with glandular or other organic disease, symptoms of compression, either of the bronchi or large vessels, are not usually observed. But in the latter case there may be not only symptoms of venous and bronchial obstruction, but even serious laryngeal symptoms and paroxysms of severe dyspnœa. The abscess may open either into the trachea, bronchi, or pleural cavity, if no external outlet is obtained. Spontaneous external opening is said to occur most frequently on a level with the second rib, to the left of the sternum.

Prognosis.—The prognosis of mediastinal inflammation should, in view of its possible terminations, be guarded.

Treatment.—Unless the acute symptoms of phlegmonous inflammation should be well marked, but little can be done in the way of treatment, beyond allaying pain, and the use of local soothing applications. Strict rest should be enjoined, and an external opening should be made for the outlet of matter, so soon as distinct indications are presented of its presence. It should also be borne in mind that the inflammatory action is liable to spread, and to involve either the lungs or the pericardium.

2. **Mediastinum, Morbid Growths connected with.**—By far the larger proportion of intrathoracic growths originate in the mediastinum, and for the most part in the lymphatic glands. Others, which may commence in the lungs or pleura, involve, sooner or later, the mediastinal spaces. In treating, therefore, of mediastinal tumours, from a clinical point of view, it is of less importance to determine their precise origin than to ascertain the general character of the growth, its modes of development, and the effects likely to be produced on the surrounding textures. It is manifest, however, that the particular site of the growth must exercise an important influence, both on the early symptoms, and the subsequent features of the case. It is necessary, therefore, to remember, when forming a diagnosis in cases necessarily very obscure in their early stages, how very various are the situations and relations of the growths. Thus either functional derangements of the heart, neuralgic pains of the muscles, dysphagia, spasmodic affections of the larynx, bronchial irritation, or limited pleuritic symptoms, may be the earliest indications.

Varieties and Symptoms.—Almost every form of morbid growth has been met with in the mediastina: cancer in all its varieties; sarcomatous, osteosarcomatous, enchondromatous, and fibrous tumours; lymphadenoma; and lardaceous, steatomatous, and tubercular masses. The progress and duration of the disease will differ materially, according to the natural history of these several formations. The growth of some is much more rapid than that of others. By some the adjacent textures are much more readily invaded

than by others. Constitutional symptoms and impairment of the general health are much more pronounced in some than in others. Apart, therefore, from the special features given to each case by the particular locality of the disease, there will be very great differences in its general aspect and progress. And were it only in reference to prognosis, irrespective of treatment, it would be very desirable to determine the nature as well as the existence of the growth. This, unfortunately, in many instances, cannot be done; but in others we may form an opinion with considerable confidence. The development of the malignant growths is generally much more rapid than that of the more innocent, and the duration much shorter. It is seldom that the duration of an intra-thoracic growth of a malignant character extends beyond a year. Those having the character of lymphadenoma or lymphosarcoma are sometimes of much longer duration. These in a large proportion of cases commence in the lymphatic glands of the posterior mediastinum, or in the anterior mediastinum, from, as some believe, remains of the thymus gland. They sometimes attain to an enormous size, and may ultimately involve all the structures within the thorax, including the heart and pericardium. In other instances, commencing probably in the connective tissue, the disease spreads along the roots of the lungs and sides of the bronchi, extensively involving the adjacent tissues and the lungs themselves, without, for a long time, giving rise to any considerable tumour. In other cases several distinct tumours are developed at some distance apart. The period at which pleuritic effusion, or œdema of the external parts occurs, also varies greatly. Thus, too, it happens that alterations in the external form of the chest are early manifest in some cases, and not till later in others. In some instances these alterations of form are limited, in others they implicate the whole of one side, or even the whole contour of the thorax. In not a few instances, whilst the growth is still of limited extent, and confined to the posterior mediastinum, the symptoms so closely resemble those of aneurism as to make the diagnosis extremely difficult and uncertain. The more prominent symptoms are indeed in some instances, and for a long time, mainly cardiac. In the most malignant types of disease, and where, as in far the greater number of instances is the case, the lymphatic glands of the thorax have become implicated by extension of disease from other organs, the local thoracic symptoms are from the first associated with those general symptoms which are characteristic of malignant disease, and pass under the term of cancerous cachexia. Sarcomatous tumours, on the other hand, attain a considerable size without constitutional symptoms of any special character. As a rule it may be said that all intra-thoracic growths tend to develop inwards rather than outwards; and thus often overlap the lungs and heart, pass along the great vessels and nerves, and press on those parts that offer least resistance. It is only in very rare instances that the chest-walls become eroded by the outward pressure of the tumour, as in so many cases of aneurism. This is the more remarkable because in many instances the presence of the growth is distinctly indicated by external tumour, arising from outward pressure of portions of the chest-walls. This is of course especially the case when the growth is in immediate proximity to the walls of the chest. In the case of large tumours the external form of the chest may be rendered unsymmetrical by displacement of the heart, and downward pressure on the diaphragm and liver. There is, however, another and very distinct mode by which the symmetry of the chest is affected, and that is by collapse of the lung and sinking of the chest-wall, in consequence of the pressure exercised on the root of the lung, by the progressive advance of the tumour. The effect of this is sometimes rendered still more apparent by the corresponding expansion of the opposite lung, either from congestion or induced emphysema. The deformity of the chest attains its maximum in many cases by the outgrowth of tumours above the clavicle and along the neck. It may be well, however, at the risk of some repetition, to classify, under different heads, the most characteristic of the multifarious phenomena that have been observed in connection with the different varieties of mediastinal growths.

*Derangements of the circulation.*—Derangements of the circulation, which are necessarily induced, in all cases, to a greater or less degree, give rise to phenomena which are of special diagnostic importance in mediastinal tumours. The return of blood through the vena cava superior and its affluents is early impeded, more or less, in the majority of cases, and sometimes to such an extent as to give a special aspect to the case. It is not, however, simply by pressure on the venous trunks that the indications of pulmonary congestion, œdema, and cyanosis are induced. In many cases the veins themselves, although seldom the arteries, are involved in the cancerous disease; and when this is not the case, there is often a special tendency to thrombosis and obliteration both of the large veins and of their radicles. Cancerous deposit has, in some cases, been traced into the jugular and subclavian veins, entirely occluding them; in other cases these vessels have been enormously distended. Thus we have in many instances great tumefaction of the face, neck, and upper extremities, from œdema and general serous infiltration. In like manner the circulation through certain portions of the lungs may give rise either to hæmorrhage in the form of hæmoptysis, or to sanguineous effusion into the pleura, or to large apoplectic clots, that is, infarcts. In this latter way the physical signs of consolidation are sometimes suddenly induced, or increased; and after death the pleural cavity has been found occupied by large protuberances from the pleura, consisting simply of blood-tumours, due to extravasation into the pulmonary tissues. Although the arteries are much less liable to become implicated in cancerous disease than the veins, they are subject, like all the other contents of the thorax, to pressure. The force of the current of blood through them may thus be diminished, and there may be a marked difference in the radial and carotid arteries of the two sides, just as there is in aneurism of the aorta. It is needless to say that the symptoms arising from mechanical influences acting on the heart must be very various. This organ may either be dragged from

its natural situation, or surrounded, more or less completely, by the advancing disease, and its situation and action concealed from all observation; or its very substance may become involved in the spread of the disease, and the pericardium may be largely distended by serous and bloody effusion. Apart from those disturbances of the heart's action arising from interrupted circulation through the lungs, its innervation may be seriously affected, as will be subsequently noted. And it is evident that the sounds, rhythm, and impulse will be affected in more ways than one; even when neither the valvular apparatus nor any other structure is the actual seat of disease. In the malignant forms of disease the muscular power of the heart is generally impaired, and there is a consequent tendency to palpitation and faintness, often associated with nausea and vomiting. Such symptoms have been observed in rare cases, where the heart has become implicated by disease extending from the mamma through the thoracic walls.

*Febrile symptoms.*—Mediastinal tumours are not as a rule characterised by febrile disturbance, at any period of their course. Several examples of tumours having the character of lymphadenoma have, however, exhibited striking exceptions to this rule. The writer has recorded a remarkable instance, and others have been recorded by the late Dr. Murchison and Dr. Church, in which there was persistent elevation of temperature, and rapidity of pulse and respiration, but with daily alternations of rise and fall. And in these instances it is remarkable that the pyrexia declined with the advance of the disease to its fatal termination. Intercurrent inflammatory affections, whether of the pulmonary tissue or of the pleura, may in any case occasion corresponding symptoms of fever. These, however, are seldom very pronounced.

*Disturbances of innervation.*—Disturbances of innervation occur at all stages, and in connection with every variety of growth. They vary, however, greatly in their character and severity. Although pain may be said to be present in most instances, it is often, all through the case, by no means a prominent symptom. The patient's distress, often very great, is more frequently due to dyspnœa and interrupted circulation, than to direct implication of the nerves. Nevertheless neuralgic pains are among the most frequent of the early subjective symptoms, and are sometimes severe in the later stages. When from the situation of the growth the recurrent laryngeal nerve is early implicated, we sometimes get paralysis of the vocal cords and aphonia, at other times spasmodic paroxysms of dyspnœa, and urgent laryngeal symptoms. In rare cases cancerous disease of the posterior mediastinum has invaded the spine, and given rise to paralysis of the limbs and trunk. The cough, which is generally due to more or less bronchial irritation and secretion, sometimes arises from purely nervous reflex irritation, and may occur in paroxysms like those of whooping cough. The innervation of the heart may be so disturbed as to occasion symptoms of angina, as well as various irregularities of action and tendency to fainting. The immediate cause of death is not infrequently to be attributed to sudden interruption of the heart's action.

*Respiratory phenomena.*—The respiratory phenomena, although presenting the utmost diversities, have nevertheless certain special characteristics. When the patient is at rest, there is often nothing to denote any impediment to the respiratory function—no quickened movement, no alteration of aspect, no expression of anxiety, but on the least exertion, dyspnœa is at once manifested. Mere change of position may induce a paroxysm of dyspnœa. With advancing disease implicating at length the contents of the thorax to a great extent, there may be no corresponding increase of dyspnœa, especially if the progress be slow. In other cases, with physical signs of a very questionable and limited character, there may be great distress in breathing. Absence of apparent dyspnœa is sometimes the more remarkable from the manifestly diminished movement of the chest-walls, or even complete immobility perhaps of one side. Nor in many cases does the dyspnœa correspond with the evidence of pressure, and the absence of respiratory sounds on auscultation. The want of correspondence between the physical signs and the functional symptoms is indeed often most striking. In one case there will be persistent difficulty of breathing, amounting to orthopnœa of the most urgent character, in another merely a little quickened respiration—lividity and turgescence of features in one case, in another an anæmic aspect.

*Physical signs.*—So long as a mediastinal tumour remains of but small size, it will, of course, not be recognisable by external physical signs, except such as are due to mechanical derangements of the circulation, generally denoted by enlargement of the external superficial veins. Comparatively small tumours will, however, sometimes manifest themselves by circumscribed alterations in the external aspect of the chest. This of course will depend much on the site of the tumour. Tumours of the anterior mediastinum may very early manifest themselves, by throwing forward the sternum and the sternal attachments of one or more of the ribs, and ultimately rendering the two sides of the chest asymmetrical. It is in these cases, when, with the growth of the tumour, the heart and aorta become overlapped and pressed on, that we have evidence of pulsation and vibration, simulating closely the signs of aneurism, and sometimes attended by a cardiac bruit. In other cases the growth, extending upwards, shows itself by tumefaction and swelling above the sternum and clavicles, being then often attended by signs of pressure on the trachea or bronchi. When the posterior mediastinum is the chief seat of disease, this may attain to very considerable development before any very decided alteration is seen in the form of the chest, unless one or other pleura have become distended by fluid effusion. The diagnosis of these latter cases often presents the utmost difficulty, the physical signs being simply those of pleuritic effusion, and the symptoms such only as may be fairly referred to the mechanical effects of fluid pressure. When the tumour is of any considerable size, the motions of those parts of the chest-walls which are in immediate proximity to the growth are almost always impeded, and there is evidence of diminished expansion. This is also the case when the

pleura is occupied by secondary growths, when there may be obliteration of the intercostal spaces, as in pleurisy. But as collapse of the lung sometimes takes place with little or no pleuritic effusion, there may be falling in of one side of the chest, appreciable by the eye, as well as by measurement. As, however, the tumour usually extends more to one side than the other, the measurements of the two sides will generally differ, from this cause alone. By percussion and palpation the ordinary signs of solidification will of course be detected, whenever the tumour approaches the chest-walls and attains to any size, or whenever any considerable portion of the lung has been rendered solid, either by invasion of the growth, by pneumonic consolidation, or by hæmoptic engorgement. Signs of displacement are often manifest comparatively early, and later on may be of the most unmistakable character. The heart may be dragged away from its natural situation in various directions; the diaphragm thrust down; the lower ribs thrown out; and the deformity of the anterior part of the chest, and the physical signs on auscultation and percussion, may be greatly modified, by distension of the pericardium from effusion. It will at once, therefore, be seen that the cardiac signs will be of very variable and diverse character—so much so that any detailed description would be of little practical use. It should also always be remembered, that the lung undergoes very various and opposite changes as the result simply of pressure on the bronchi, and interruption to the entrance and egress of air from the air-cells. Thus in the early stages there may be more or less of emphysema, and corresponding physical signs on the affected side; and in more advanced cases a certain amount of emphysema of the opposite side. As the bronchi become occluded, we have at first the stethoscopic signs of accumulation of secretion, soon to be followed by signs of consolidation and absence of respiration, when the lung is undergoing those destructive changes by which it becomes converted into a solid mass broken up by irregular abscesses or pockets of pus, produced in part by actual pulmonary disintegration, and partly by dilatation of the bronchi. In the latter condition there may be enlargement of the lung and distension of the side, rather than collapse. Hyper-resonance from emphysema, followed by signs of consolidation and absence of all respiratory phenomena, associated with or preceded by other indications of pressure, would be tolerably decisive of the existence of a mediastinal tumour, but whether aneurismal or some form of malignant disease might still be a question.

Diagnosis.—From the preceding remarks it will be evident that there are no symptoms or physical signs, nor any precise order of phenomena, that can be said to be peculiar to, or diagnostic of, an intra-thoracic growth. No two cases will be found to be precisely alike. Nevertheless, the want of correspondence with the ordinary forms of thoracic disease; the very general presence of signs of pressure and mechanical derangement; and the varying aspects of these signs are, in the majority of cases, when considered in conjunction with the history of the case, sufficient to lead, if not to a positive, at least to a probable diagnosis. In the early stages of a mediastinal tumour, when the growth is still small, it will be easily seen, if we reflect on the anatomical relations of the mediastinum, that an accurate diagnosis must often be impossible. And even when formidable symptoms arise from the peculiar relations of a small growth, it must often be extremely difficult to avoid error. Both retro- and antero-sternal nodes will sometimes closely resemble both aneurism on the one side, and mediastinal tumours on the other. For further remarks on the physical diagnosis, the reader is referred to the articles Lungs, Malignant Disease of; Mediastinum, Inflammation of; and Thoracic Aneurism.

Treatment.—There is but little that can be said as to the treatment of mediastinal tumours, except as regards the palliation of urgent symptoms, or the relief of some of the chief secondary effects of the original diseases. All forms of intra-thoracic growths of a malignant character are steadily progressive to their fatal termination. Some of the less malignant in character—for example, lymphadenomatous tumours—may last a long time, and appear for a while to be stationary, and unattended by any serious impairment of the general health. Even these, however, are exceptional cases. Bodily rest, freedom from causes of moral disturbance, maintenance of the general nutrition, change of air, and every available hygienic means, are essential in all cases. Chalybeates and other tonics may be of more or less service. Special symptoms often admit of considerable relief; for instance, local pains by external soothing applications, or counter-irritants, such as sinapisms and small blisters. The latter are often of signal benefit. Pain, sleeplessness, and harassing unrelieving cough may all be alleviated by opium and other narcotics, such as chloral or bromide of potassium, and sometimes by minute doses of antimony. For the distressing paroxysmal attacks of dyspnœa and laryngeal spasm, opium and its preparations require to be given with caution; but chlorodyne, Hoffman's ether, and the inhalation of chloroform are often useful. The distress arising from dyspnœa and inability to lie down will often tax the resources of the physician to the utmost, depending as they do on a variety of complex causes. When they appear to be mainly referrible to accumulation of fluid in the pleura, paracentesis must be resorted to, and will often be followed by great temporary relief. At one time the writer was averse to this procedure, but further experience has led him to believe that it is productive of little if any mischief, and that life may sometimes be much prolonged by even repeated evacuation of the pleural effusion. In proportion as symptoms of pleurisy, bronchitis, or pneumonia predominate, they must be met by the ordinary therapeutic resources. It remains to be seen whether our further knowledge of the natural history of lymphadenoma may advance our therapeutic resources. Certainly the slower progress of such cases affords more time for the trial of iodine, chalybeates, or other constitutional remedies. It should ever be borne in mind that severe attacks of dyspnœa, with stridulous breathing and other indications of intra-thoracic pressure, may all

be due to nerve-irritation alone, and often be greatly alleviated by small doses of morphia combined with antispasmodics.

J. Risdon Bennett.

**MEDIATE** (*medius*, a means).—A term applied to auscultation and percussion, when some medium is interposed between the surface of the body of the patient and the ear or finger of the physician, such as the stethoscope in the one case, or a pleximeter in the other. *See* Physical Examination.

**MEDITERRANEAN, The.**—Moderately dry and warm, and very sunny winter climate. *See* Algiers; Cannes; Hyères; Nice; Mentone; Malaga; San Remo, &c.; and Climate, Treatment of Disease by.

**MEDULLA OBLONGATA, Lesions of.** Synon.: Fr. *Maladies de la Moelle allongée*; Ger. *Krankheiten des verlängerten Marks.*

Introduction.—The pathology of the medulla oblongata is more than usually complex. Not merely is it liable to injuries, and diseases such as hæmorrhages, softenings—necrobiotic and inflammatory, tumours, &c., having their primary seat here, as in other nerve-centres; but also, and more frequently, the medulla is implicated in diseases of the pons and cerebellum, and affected indirectly by intracranial diseases in general. Being the connecting link between the brain and spinal cord, it is subject to ascending or descending degenerative processes, secondary to lesions in the cerebral or spinal sensory and motor tracts. Further, it is the seat of a special form of degeneration, characterised by a very definite group of symptoms, differentiated under the term bulbar or labio-glosso-laryngeal paralysis.

With the indirect affections of the medulla oblongata, in connection with the various forms of intracranial disease, degenerations of the sensory or motor tracts secondary to cerebral or spinal disease, or the pathology and symptomatology of bulbar paralysis, this article does not profess to deal, as these subjects will be found fully discussed under other headings. Attention will be directed mainly to the data which serve to establish, so far as this is possible, the regional diagnosis of medullary lesions.

Summary of Pathological Conditions.—*Traumatic lesions.*—Injuries of the medulla oblongata are not uncommon in consequence of fracture or dislocation of the atlas and axis, as in falls, hanging, twisting of the neck, or as the result of diseased vertebræ. In such cases death is instantaneous, owing to the sudden cessation of the circulation and respiration, from lesion of the centres of these vital functions, which are situated in the medulla (Flourens' *nœud vital*).

To commotion or contusion, with punctiform extravasations in the medullary centres (Duret, *Sur les Traumatismes Cérébraux*, 1878), is also to be attributed sudden death from blows on the head. Not unfrequently lesions of the fourth ventricle, the result of cranial injuries, not proving fatal, give rise to diabetes mellitus or insipidus, along with other symptoms indicative of chronic lesion of the pons or medulla.



Effusions of blood into the fourth ventricle, whether arising from the medulla itself, the pons, or the cerebellum, or gaining access from the lateral ventricles by the aqueduct of Sylvius, are, as a rule, suddenly fatal from paralysis of the circulation and respiration. Death may occur with or without convulsions.

*Tumours.*—Tumours implicating the medulla oblongata may have their seat primarily in the medulla; but more commonly the tumours are situated at the base of the skull, in the cerebellum or pons, and invade the medulla in their growth. Apart from the general symptoms of cerebral tumour—headache, sickness, optic neuritis, &c., the special indications of implication of the medulla oblongata are one or more of the symptoms mentioned below. Here also, however, some remarkable cases have been put on record, in which, notwithstanding the existence of tumours actually in the substance of the medulla itself, the symptoms during life have presented nothing striking or characteristic. (See a case by Dr. Wiiks, *Diseases of the Nervous System*, 1878.)

*Hæmorrhage.*—Hæmorrhage into the substance of the medulla oblongata, and limited to this, is comparatively rare. More commonly the pons and medulla are affected together. Hæmorrhages here of any extent are very rapidly fatal. In some cases death is instantaneous. In others a few hours may elapse, death occurring in profound coma with stertorous respiration, and occasionally convulsions. Whether the hæmorrhage is primarily in the medulla or in the pons cannot be diagnosed with certainty. The other causes of sudden death, such as affections of the heart, must be excluded before hæmorrhage into the medulla can be diagnosed, and this is in many circumstances obviously impossible.

Hæmorrhage into the medulla oblongata is usually fatal, and rarely gives rise to chronic stationary lesions. These are usually the result of thrombosis or embolism, or, more rarely, acute myelitis.

*Thrombosis.*—Thrombosis of the vertebral arteries is the most common origin of softening limited to the medulla oblongata. The onset is frequently sudden, as in hæmorrhage, but the course is more slow. The more chronic nature of the affection is an important diagnostic feature of softening. The symptoms of softening of the medulla thus arising are in many respects like those of progressive bulbar paralysis, but there are also important differences. They are sometimes generalised under the head of 'acute' or 'apoplectiform' bulbar paralysis, in contradistinction to the classic form of this affection described by Duchenne. *See* Labio-Glosso-Laryngeal Paralysis.

Localising Phenomena.—The symptoms met with in the affection just named are the most reliable clinical data on which to found a regional diagnosis of lesions of the medulla oblongata. The characteristic symptoms are a conjoint affection of the extremities and one or more of the bulbar cranial nerves, with impairment of speech and deglutition, and cardio-respiratory disturbances. Sometimes all four extremities are paretic or paralysed; sometimes the lower extremities alone; and occasionally the paralysis is of the hemiplegic order.

If the paralysis affects only the extremities, without implication of the bulbar nerves, as sometimes occurs, a diagnosis of the medullary seat of the lesion cannot be made with certainty. Anæsthesia has not been recorded, but occasionally paræsthesiæ have been observed. Ataxic affections of the extremities have also been met with by Leyden and Prévost.

Of the cranial nerves the hypoglossal is most commonly involved. The symptoms are impaired mobility of the tongue, with more or less pronounced dysarthria. This is not absolutely characteristic of bulbar disease, however, as a similar affection of the hypoglossal may occur in disease of the pons. The tongue and speech are rarely, if ever, so affected as in the classic or progressive bulbar paralysis, nor has the atrophy of the muscles of the tongue, with altered electrical reactions, been noted.

Of more importance as a diagnostic mark is dysphagia, or paralysis of deglutition. This, in the absence of general cerebral symptoms, points to affection of the medulla. Paralysis of the soft palate, on one or both sides, is also a frequent, if not constant, symptom. Occasionally also aphonia occurs, and, taken with the other symptoms, points conclusively to affection of the medulla oblongata.

Irregularity of the heart; acceleration or retardation of the pulse; and sighing and laboured respiration, often amounting to orthopnœa, in the absence of general cerebral symptoms, are also important indications of disease of the medulla oblongata. Among other symptoms have been noted coughing, and vomiting, explicable by affection of the respiratory centres. Trismus has been mentioned by Joffroy as a characteristic symptom of acute bulbar paralysis, but Nothnagel, on good grounds, disputes the accuracy of this statement.

Albuminuria and glycosuria have also been observed in connection with bulbar lesions, the latter more particularly after injuries affecting the floor of the fourth ventricle; but the occurrence of these symptoms in connection with acute bulbar paralysis requires further investigation, as they cannot as yet be regarded as constant.

An affection simulating disease of the medulla oblongata results from bilateral lesion of the anterior third of the internal capsule (Lépine), or of the cortex in the region of the lower extremity of the ascending frontal and posterior extremity of the third frontal convolution (Barlow). Such a bilateral lesion causes paralysis of articulation, and also true aphasia if the lesion is cortical, along with a greater or less degree of double hemiplegia. The diagnosis must depend on the truly volitional character of the paralysis in such cases, the reflex mechanism of deglutition being unimpaired. There will also be absence of affection of sensibility and of trophic degeneration of the muscles, and absence also of disturbances of the cardiac and respiratory rhythm. Defective comprehension of speech, and obvious aphasia—the movements of articulation not being absolutely paralysed, and also agraphia—the hand not being completely powerless—will differentiate cerebral from bulbar paralysis.

D. Ferrier.

**MEDULLA OF BONES, Diseases of.**—Synon.: Fr. *Maladies de la Moelle des Os*; Ger. *Krankheiten des Knochenmarks.*—The morbid conditions of the medulla of bones are most conveniently described under the head of the several diseases of which they almost invariably form but a part. Thus, injuries, acute and chronic inflammation or osteomyelitis, and the majority of new growths involving the marrow, affect the bone as a whole, and are accordingly discussed in the article upon these subjects (*see* Bone, Diseases of). Myeloid tumour, which is peculiarly connected with the medulla, is also described and figured in the article on Tumours.

The medulla of bones is also the seat of important pathological changes in several chronic constitutional diseases. For instance, it is affected in some cases of leucocythæmia, and of lymphadenoma; in mollities ossium; and in rickets. The reader is referred to the description of the anatomical characters of these conditions in the articles bearing their several names.

**MEDULLA SPINALIS, Diseases of.** *See* Spinal Cord, Diseases of.

**MEDULLARY CANCER.**—A synonym for encephaloid cancer. *See* Cancer.

**MEGRIM.**—Synon.: Migraine; Sick Headache; Nervous Headache; Hemicrania; Fr. *Migraine*; Ger. *Migräne.*

Definition.—Headache of a periodical character; generally ushered in by some premonitory symptoms; more or less unilateral; and frequently associated with nausea and bilious vomiting.

Ætiology.—The chief predisposing causes of attacks of migraine are hereditary tendency, anæmia; a general want of tone in the system; and the nervous temperament. Among the exciting causes may be included all those of a depressing or exhausting nature, whether physical or mental, such as prolonged mental work, mental excitement, grief, anxiety, bodily fatigue, late hours, sexual excesses, breathing the impure air of a crowded room, and improper food.

Symptoms.—This complaint seems to have two more or less well-defined stages, the headache being preceded for a variable period by certain disorders of sensation. In some persons the malady stops short here, and is not followed by headache; in others the headache appears to be developed without any premonitory symptoms, until careful inquiry reveals the contrary. The two stages therefore are, first, the stage of disordered sensation; second, the stage of headache, with other symptoms.

The most striking of the disordered sensations is a transient disturbance of vision which sometimes takes place. It commences with a wavy glimmering near the outside corner of the field of vision, and spreads all over the visual area with a zigzag outline, in a straight-lined angular pattern, and with or without lines of colour between the darker lines. Or it may commence by the appearance of a blind spot close to the centre of vision, which soon begins to spread, showing a serrated margin, and presenting a tremor or wavy glimmering in its interior.

This condition is often associated with a feeling of chilliness, coldness of the hands and feet, or other symptoms; it may last from five to thirty minutes or longer, and then be succeeded by the stage of headache.

On the other hand, the headache may be, and in many individuals always is, developed without the ocular disturbance, but other sensations are substituted for it. The patient has a feeling of chilliness, and the feet are cold. There is mental depression, with a dread of impending evil; the patient is restless and uneasy; 'cannot quite tell,' as he says, 'what he would be at;' and has what is expressively called 'the fidgets.' This condition may continue half an hour or more, and then the slight boring piercing pain is felt in the head, with which the aching begins; and the disorder runs its course, as will be presently described. In other cases, this feeling of depression or uneasiness lasts for several hours, the patient goes to bed, and in the early morning wakes with the headache fully developed.

The headache, when preceded by ocular disturbance, shows itself as follows:—When the vibratory movement is at its height, a little aching is felt in the head, on the side *opposite* to that on which the glimmering first appeared: it is slight at first, but gradually increases in intensity. Some persons have said that the sensation was as though a point in the temple were being bored with a gimlet, and the gimlet slowly increasing in size. The pain gradually spreads from this point, which may be covered with the finger, and pressure upon which affords relief, first over one side of the head; and then, but not always, it extends to the other. As the headache increases, the ocular disturbance declines; nausea is felt, which increases with the headache; retching and vomiting occur, the latter sometimes, though rarely, giving relief; the head throbs; the slightest movement increases the pain, and any attempt to move from the recumbent posture increases the gastric uneasiness; the mouth feels clammy; the eyeballs ache, and are tender on pressure, one more so than the other; the pupils are rather contracted, and generally unequally so; and the patient lies apparently more dead than alive, his face pale, and the head hot. After a varying number of hours he is somewhat relieved by troubled sleep; he wakes up next morning free perhaps from headache; but he is listless; his brain is weary; and he feels as if he had undergone a hard mental struggle. There may be now an interval of a few days, weeks, or years, before the disorder again shows itself.

The headache varies much in character, degree, and duration. In some persons the pain is not localised in any particular spot, but seems generally diffused over the head; others have not noticed that there is more pain on one side of the head than the other, or that the aching radiates from one painful spot, until their attention has been directed to the fact, and then they distinctly recognise it; others, again, have neither vomiting nor nausea; and lastly, the duration of the headache may be very short, or not extend over more than two or three hours, or this symptom may be entirely absent. The disorder may even stop short at the vibratory stage, the vision be restored, and no further inconvenience felt.

In a certain proportion of cases during the vibratory stage a tingling is felt in some portion of the body—the part is 'asleep.' Sometimes it is felt in one arm or in the side of the tongue, or on the side of the face, and it is on the same side as that on which the glimmering in the eye begins. Sometimes the hearing, speech, or memory is affected.

The age at which the attacks generally commence is from twelve to twenty-five. Females are more liable to them than males. After a certain period, with advancing age the attacks, as a rule, are less easily developed, and become much less frequent. They cease generally after fifty or sixty, and in women not uncommonly at the change of life.

Pathology.—Considerable diversity of opinion exists as to the nature of megrim. Formerly it was regarded as being dependent upon gastric or hepatic derangement, a view, however, which now finds few supporters. Some pathologists hold it to be a form of neuralgia; but though it has a great resemblance to neuralgia, it 'causes much greater disturbance of the sensorium, it spreads much more generally over the head, and is not unfrequently accompanied with nausea and vomiting. After the attack there may be an intermission of weeks or months, and the attack itself runs a more uniform or continuous course' (Lebert). The view which the writer has advanced is that the affection is to be referred to the sympathetic nervous system. If by fatigue, anxiety, or other depressing cause, the general tone of the body be lowered, and with it the regulating or inhibitory power of the cerebro-spinal over the sympathetic nervous system impaired, then uncontrolled action or excitement of one or more portions of the latter takes place, causing contraction of the blood-vessels under the influence of the affected portions, and so producing the disorders of sensation which precede the headache; this excitement is followed by exhaustion or paralysis of the sympathetic, and is associated (just as would be the case after section of the nerve) with dilatation of the vessels, and with headache. Dr. Edward Liveing, in his classical and exhaustive work on megrim, combats this view, and maintains that the phenomena are those of 'a nerve-storm traversing more or less of the sensory tract from the optic thalami to the ganglia of the vagus, or else radiating in the same tract from a focus in the neighbourhood of the quadrigeminal bodies.'

Treatment.—By careful management very great relief can be afforded to the sufferers from this malady, not only by diminishing the intensity of the attacks, but also by considerably lengthening the intervals between them. We may consider separately the remedial measures to be employed (1) during the intervals between the attacks; (2) during the premonitory stage or stage of disordered sensation; and (3) during the stage of headache.

1. *During the intervals between the attacks.*—It is to the treatment during this period that the greatest consideration must be given. The cause, if possible, must be discovered, and in a

very large majority of cases, careful inquiry will reveal the fact that a distinct cause does exist. Overwork, prolonged anxiety, over-fatigue, disappointed hopes or affections, sexual irregularities, and impoverished nutrition of the body, are among the chief causes; and while these are in operation medicine will prove of little avail. Remove the cause, and then endeavour to brace up the bodily and nervous systems. The chief remedies for this purpose are the vegetable bitters, iron, strychnine, and cod-liver oil. But the success following their use very much depends upon the way in which they are administered. For a day or two after a headache the stomach and bowels may possibly be disordered, and not in a fit state to tolerate iron or cod-liver oil. This condition must be corrected, and for this purpose the simple vegetable bitters, such as gentian with small doses of henbane and some aromatic, may be of service; and if necessary one or two grains of blue pill, with four or five of compound rhubarb pill, may be given at night, but strong purgation must be avoided. Iron may then be given, either in the form of the ammonio-citrate alone, or combined with two or three grains of iodide of potassium; and according to circumstances fifteen or twenty minims of tincture of henbane, or twenty or thirty minims of aromatic spirit of ammonia, may be added to each dose. Or the iron may be given in the form of the mistura ferri composita of the Pharmacopœia; the mixture answering better, however, in some cases without the myrrh. Strychnine is, in the writer's opinion, a very important remedial agent in many forms of this disorder, and may be given with the remedies previously mentioned in the form of liquor strychniæ or tinctura nucis vomicæ, or may be combined with infusion of quassia or calumba. Where iron is contra-indicated from any cause, or when it is not readily borne, the administration of nux vomica with quassia has seemed to act beneficially. In females with a distinct hysterical temperament nux vomica does not answer so well, and better results will be obtained by giving the vegetable bitters with ten-grain doses of bromide of potassium, and fifteen or twenty of tincture of henbane, twice or three times a day. As a rule, however, the bromide is of more use administered during the headache than in the intervals. Cod-liver oil often acts beneficially, especially when there is much nervous exhaustion. It may be given once a day immediately after breakfast, beginning with a small teaspoonful, and gradually increasing the quantity to a tablespoonful, but not beyond, unless in exceptional cases. If the bowels are constipated, five grains or so of the socotrine aloes pill may be given at night; or if the constipation be habitual, five grains of the aloes-and-iron pill, given twice a day before meals, will generally induce greater regularity in the action of the bowels.

Other remedies have been recommended, and are sometimes of service, especially arsenic and quinine.

In persons of feeble bodily power, rest is of the greatest importance, and it is often advisable that such patients should remain in bed at least twelve hours out of the twenty-four, and take their breakfast an hour and a half or two hours before rising in the morning. Whenever the headaches recur frequently, this rule should be enforced. In many cases a tumblerful of new milk, to which two teaspoonfuls of brandy, rum, or whisky have been added, may be taken with advantage before breakfast, directly on waking in the morning.

The diet should be liberal; the food plain and easily digestible; and two or three glasses of wine, beer, or porter per diem, may generally be taken with benefit. The more exercise the patient can take in the open air, without fatigue, the better.

2. *During the premonitory stage, or stage of disturbed sensation.*—In the forms attended by disturbance of vision, the longer this lasts the greater will be the headache, and we must endeavour therefore to shorten this stage as much as possible. Directly the glimmering appears the patient should lie down, with the head low; and if the glimmering be on the right or left of the field of vision, he should lie on the *opposite* side. Let him take at once some alcoholic stimulant, a full-sized glass of sherry, a large tablespoonful of brandy diluted, or a glass of champagne. If alcoholic stimulants be objected to, or if it be not advisable to recommend them, then a teaspoonful of sal volatile in water may be prescribed instead. If the patient be chilly, or his feet cold, the couch should be drawn near the fire, and a hot bottle applied to the feet. By these means the heart is enabled to drive the blood with greater force to the brain, and the duration of the vibratory movement is thereby materially lessened. After the glimmering has passed off, the patient should lie still for a time, so that it may not return. This injunction will only be necessary when the headache is slight; if it be severe, attended with much nausea or vomiting, the patient will be little disposed, or little able, to leave the recumbent position.

If, instead of the disturbance of vision preceding the headache, there be a feeling of depression or irritability, fidgets, and similar phenomena, the administration of such cerebro-spinal stimulants as henbane, valerian, assafœtida, spirit of chloroform, or ether, will often cut short the attack. Fifteen or twenty drops of the tincture of henbane, with the same quantity of spirit of chloroform, will soothe the nervous irritability in the slighter forms, and may be repeated in three or four hours if necessary. If there be great mental depression, then valerian or assafœtida should be tried. Half a drachm to a drachm of the ammoniated tincture of valerian, or the same quantity of the fetid spirit of ammonia may be given. As a rule, in such cases as these, alcoholic stimulants are not advisable at this stage. A small quantity will cause flushing, heaviness, and slight confusion of thought, without relieving the depression; and though the severe headache may be averted, alcoholic stimulants do not answer so well as the remedies previously mentioned.

3. *During the stage of headache.*—If the headache be slight, and the patient soon able to sit up, there is little to be done. A cup of coffee or tea, cheerful conversation, a walk, drive, or ride, may often help to remove the pain. If, however, the symptoms be severe, then the adminis-

tration of further remedies is called for. The patient should keep perfectly still and quiet, with the room darkened; for every sound or sight causes pain, and the slightest movement is sufficient to produce gastric uneasiness. Sometimes free evacuation of the contents of the stomach, especially if it contain undigested food, is followed by relief; but, as a rule, it is better to try to relieve and check the vomiting. Iced soda-water, with or without two or three drops of dilute hydrocyanic acid or spirit of chloroform; cold tea; or the effervescing citrate of potash with hydrocyanic acid, may often afford marked relief. The headache may be lessened by applying cloths dipped in cold water or evaporating lotions to the head. If the extremities be cold, and the headache severe, a warm stimulating foot-bath can be tried, so soon as the nausea will allow the patient to sit up. If the attacks occur in the early part of the day, as soon as the pain has subsided it is generally better for the patient to sit up or move about, or even to take exercise in the open air. During the attack the appetite is diminished, the idea even of taking food provoking disgust. Still, after the nausea has passed away, a plate of soup, or some easily digested food, will often have a good effect in equalising the cerebral circulation, and in relieving the headache. If the headache be severe, bromide of potassium is a remedy which will often prove of great service. It may be given in doses of fifteen or twenty grains, with fifteen or twenty minims of tincture of henbane, and to these may be added thirty or forty minims of the aromatic spirit of ammonia, in some cases with advantage. If necessary, the dose may be repeated after an interval of two hours or so. In other cases chloride of ammonium in doses of fifteen grains produces marked relief, and may be sometimes advantageously combined with spirit of chloroform and compound tincture of lavender. Guarana powder is a remedy which is used, often with happy results. The sick-headaches which it seems to relieve are those in which distinct premonitory symptoms usher in the attack, and particularly those preceded by disturbance of vision. It may be given in such cases in doses of fifteen grains, with the same quantity of sugar, and repeated in from half an hour to two hours. In those individuals, however, in whom the headache is developed suddenly, where the attacks come on without any or with very indefinite premonitory symptoms, guarana appears to have little effect.

As a rule, the use of purgatives in this stage is decidedly objectionable, but occasionally a saline purgative at the commencement of an attack is indicated, and is of service.

P. W. Latham.

**MELÆNA** (μέλας, black).—Synon.: *Dysenteria splenica*; Fr. *Méléna*; Ger. *Schwarze Ruhr*.

This term is used to denote black tar-like evacuations that are passed from the bowel. The colour and appearance are due to *altered* blood, and the expression is not properly applicable to simple hæmorrhage from the alimentary canal, when blood of a normal appearance is voided.

In order that the blood should have undergone the change which produces the characteristic evacuations, it must have been effused high up in the canal, and in some quantity. When hæmorrhage takes place in the lower part of the small intestine, or in the colon or rectum, the blood is passed in a scarcely altered state, or at most renders the fæces dark, without producing the black, viscid motions now referred to.

Blood that is passed into the stomach, from any cause, is subjected to the action of the gastric juice, and undergoes a partial digestion. The acid of the secretion converts the hæmoglobin into hæmatin, a blackish-brown substance, and the exposure of this to the sulphuretted hydrogen produced in the lower part of the intestine converts the iron it contains into a black sulphide. The tar-like consistency is due to the serum, digested clot, and mucus; and the discharged material is usually free from remains of food, being simply altered blood. When the hæmorrhage takes place into the upper part of the intestine, the change is not so completely effected. In place of being submitted to prolonged action of an acid secretion, with considerable power of digesting, the blood is acted upon by alkaline secretions, the efficacy of which is less, unless the ingesta have been previously affected by the gastric juice. The result is that, although the blood is to a great extent altered, and the same black sulphide of iron is formed, it becomes more or less mixed with the contents of the tube, and is not voided in lumpy clots, but almost uniformly incorporated with the fæces, which may be solid, semi-solid, or fluid. The fæces may be blackened by iron, bismuth, and other agents, taken as drugs, but they do not produce the viscid matter like semi-digested blood.

Melæna is the mere expression of a condition brought about by many causes, and these have to be sought for and treated. *See* Fæces, Examination of; Hæmatemesis; Intestines, Hæmorrhage from; and Stools.

W. H. Allchin.

**MELANÆMIA** (μελας, black, and αἷμα, the blood).—A morbid condition of the blood, in which it contains black and brown pigment-particles. *See* Blood, Morbid Conditions of.

**MELANCHOLIA** (μέλας, black; and χολὴ, bile).—Synon.: Fr. *Lypémanie*; *Mélancolie*; Ger. *Schwermuth*; *Melancholie*.—This name is now usually applied to a form of insanity characterised by great mental depression, but formerly it was used by writers to denote *partial* insanity, or monomania. The sufferer in this disorder feels his whole existence, mental and bodily, overwhelmed and oppressed by gloom, anxiety, and foreboding. At first it may be only a feeling which takes no definite shape, and there may be no delusions. Sometimes, though rarely, there are none throughout; the morbid feeling constitutes the disorder, which in this form has been called *simple* melancholia. Its access is almost always gradual, and though we may attribute it to grief, overwork, or worry, it often happens that no mental or moral cause can be found, and we are obliged to set it down to inherited predisposition, to some debilitating illness, to declining strength, or to advancing age. Some are aware that there is no real ground

for their sorrow and sadness, and are able to look on it as an illness; others feel that there must be some real cause for their despondency, that something terrible is impending, though they know not what. The majority can argue and converse rationally on subjects unconnected with their feeling of misery.

The bodily health, even if at first it appears good, soon participates in the disturbance. The digestion is disordered, the urine loaded with lithates, the skin dry, the bowels are constipated, the pulse is slow rather than quick, the conjunctiva dull and yellow. The patient will complain of various uneasy feelings in the præcordial or epigastric region, and this, with the state of the excretions, will confirm the notion, so prevalent amongst many, that the whole mischief is in the liver. Such simple depression may continue for a longer or shorter space of time. It may pass away suddenly or gradually, or the individual will grow worse in one of two ways. The depression becomes greater, and delusions of various kinds present themselves; or it is replaced by the excitement of mania.

*Melancholia with delusions* is far more common than *simple melancholia*, and is that which most frequently we are called upon to treat. The patient feels utterly changed, and attributes it to various causes, and deduces various results from it. He has all manner of diseases—syphilis, leprosy, lice; his stomach is gone, and therefore he cannot eat. He cannot attend to business, and therefore is ruined. He is so wretched that he must have committed sins unpardonable in this world or the next. The bodily symptoms, like the mental, are aggravated. Sleep is absent or scanty, and there is rapid wasting. The bowels are loaded, and resist strong purgatives; the tongue is white and furred; the breath offensive. The patients are for the most part elderly; climacteric insanity is almost always melancholia. Of 338 melancholic patients admitted into St. Luke's Hospital only 9 were below the age of twenty.

It cannot be too strongly impressed upon medical men that all melancholic patients, even those whose disorder seems simple and slight, are, especially in the early stage, very apt to commit suicide. We read accounts almost daily in the newspapers of suicides committed by this class of persons, and most lamentable they are, for it is a class which above all others is amenable to treatment.

An asylum is not absolutely requisite for such, if their means allow of proper companions, house, and exercise. They must not be left alone by night or day; must not be left to attendants only; and must have some amusement or diversion. If all this cannot be provided, to an asylum they must go; for if they are resolutely and constantly bent on suicide, it is most difficult to guard against it in an ordinary house.

Whether they are sent to an asylum or not, it is found to be almost invariably necessary to remove them from home. We may think the case a slight one, and may hope that amusement and cessation from work, with medical treatment and good living, will remove the depression. Again and again we are disappointed. The sight of home and home scenes, of family and friends, and the contrast between past happiness and present gloom, perpetuate the melancholy and prevent its dispersion. After valuable time is lost, we are compelled to send away the patient to an asylum or quasi-asylum.

Prognosis.—The prognosis in cases of melancholia is favourable, and patients get well in great numbers, even at an advanced age. It is also important to remember that recovery may take place from this form of insanity after considerable periods of time. The writer has in the second volume of the *St. George's Hospital Reports* recorded three cases of melancholia in which recovery took place after five, six, and seven years' residence in an asylum; and he has since treated a lady who recovered from a most suicidal attack of the disorder after nine years. In dealing with property it is often necessary to consider the question of probable recovery, and it is well to keep in view the chance of it here, although in perhaps every other form of insanity recovery after such periods would be out of the question.

Treatment.—On examination of a melancholic patient, it is generally found that there has been a considerable loss of flesh. This may be due to the mental care and sorrow, but it is often caused by an insufficient quantity of food, which has been scanty, either because all appetite has been lost owing to the prevailing wretchedness, or because, from various delusions, there has been an unwillingness to take food. Moreover, there is almost always considerable disorder of the digestive apparatus, the result and not the cause of the depressed nervous condition. The first thing to be done is to correct this disorder; and then to restore the defective nutrition of the brain.

One symptom is obstinate constipation. It may be necessary in the first instance to relieve the loaded and obstructed bowel by means of turpentine enemata; after which it will be of advantage to give a daily dinner pill of the extracts of aloes and nux vomica, or a daily teaspoonful of castor-oil, following it up if necessary by an enema, but ensuring an action every, or every other day, and so habituating the bowels to act. Many of these patients, especially women, will be found to be persons who have been accustomed to go for long periods without the bowels acting, or who never had relief without medicine. Food must be given to melancholic patients in large quantities. It constantly happens that it is withheld from them under the impression that their malady is essentially dyspepsia, and that the stomach must not be called upon for much exertion. Many, as has been said, refuse it for one reason or other. In either case the melancholia increases, and the patient gets thinner and weaker. Food must be given with no sparing hand, not merely beef-tea and invalid diet, but solid food, bread, meat, and eggs, with a liberal allowance of wine or malt liquor. Some may require forcible feeding, and this can hardly be carried out except in an asylum, but many by coaxing or threats will take what is given to them with a spoon, and they must be fed frequently till they will take the meals of their own accord. Under this augmented diet the tongue will become clean, the bowels will act

without physic, and the patient's appearance will soon testify to the efficacy of the treatment.

Sleep, though not entirely absent here, will be in defect. To procure it opium has been long looked upon as of the greatest value. In melancholia, of all the various forms of insanity, this drug is most useful, and its benefit consists not merely in the procuring of sleep, but in alleviating the feeling of wretchedness. It may be given either by the mouth or by subcutaneous injection. It is of importance that we do not give a preparation which shall cause sickness or constipation: the ordinary preparations of morphia, the acetate and hydrochlorate, are apt to do this if given in full doses, and it is better to substitute the liquor morphiæ bimeconatis, Dover's powder, Battley's solution, or solid opium, if we can be sure that pills will be swallowed. Chloral will procure sleep here as in other cases, and may be combined with opium to bring about more speedy action of the latter, but chloral has not such a lasting influence on the malady; when its sleep-producing effect has passed away, the patient does not feel any benefit from the medicine. When the secretions have been corrected, and digestion is re-established, tonics may be useful, especially the preparations of iron.

G. F. Blandford.

**MELANCHOLIA, Varieties of.**—1. **Melancholia, Acute.**—Although the prognosis in simple melancholia, and that which may be called sub-acute, is so favourable, there is an advanced stage which truly merits the name of *acute*, and generally terminates fatally. The patients are not silent, gloomy, and depressed, but panic-stricken; and in violent frenzy and terror they try to escape from those about them, to tear off their clothes, gouge out their eyes, and injure themselves in every way. They will not lie on a bed unless forced to do so, but will prefer the floor, or incessantly pace the room. Food they resist with all their power, thinking that it is poisoned, or that they will be punished for taking it. Such patients must be fed by force, and fed early, but it often happens that our feeding here is of no avail, and they sink from the exhaustion of this acute disorder. For it is constantly found in those who are already broken and debilitated in health, and it is but the last stage of a series of disorders. The incessant agitation, violence, and sleeplessness produce rapid wasting and sinking; the food administered is not assimilated, and fails to restore the wasted force. This form runs a rapid course, in contradistinction to the last, which is tedious, but nevertheless tends to recovery in the majority of cases. We may administer opium here with or without chloral; other drugs are of little use. Cod-liver oil may be added to the food. Warmth and stimulants are demanded; and clothes must be kept on by means of a strong suit which cannot be removed by the patient.

2. **Mélancolie avec Stupeur** (Fr.) Synon.: Ger. *Schwermuth mit Stumpfsinn.*—A more extreme form of melancholia is thus named, where the patient sits or stands, speechless and motionless, and requires to be fed, washed, and dressed. Though such a one will not speak or do anything for himself, he may be watching every opportunity of committing suicide, and refuse food with the same motive. The vital powers in these persons are greatly depressed, and they require much food and stimulant. This form has been confounded by some with that variety of insanity termed acute dementia (*see* Dementia); but the latter occurs only in young people, whereas melancholia as a rule does not; and the early symptoms are quite different, acute dementia coming on rapidly, and without the depression and gloomy delusions which mark the other complaint.

G. F. Blandford.

**MELANOMA** (*μέλας*, black).—Any morbid growth in which the presence of black pigment is a leading character. *See* Tumours.

**MELANOPATHIA** (*μέλας*, black, and *πάθος*, a disease).—An excess of black pigment in the skin, due to abnormal function of the rete mucosum. Melanopathia is rarely general, more frequently partial. In certain instances, as in the 'bronzed skin' of Addison's disease, it is associated with anæmia. *See* Pigmentary Skin-Diseases.

**MELANOSIS** (*μέλας*, black).—According to the present doctrines of pathology, melanosis signifies the condition of system associated with the presence of pigmented tumours. *See* Cancer; and Tumours.

**MELASMA** (*μέλας*, black).—A term usually applied to excess of pigment in the skin, from abnormal function of the rete mucosum. *See* Pigmentary Skin-Diseases.

**MELLITURIA** (*μέλι*, honey, and *οὖρον*, urine).—A synonym for saccharine urine. *See* Diabetes.

**MEMBRANA TYMPANI, Diseases of.** *See* Ear, Diseases of.

**MEMBRANES OF BRAIN AND CORD, Diseases of.** *See* Meninges, Diseases of.

**MEMORY, Defects of.**—There are so many different kinds of memory, and so many different degrees of excellence of each variety in different individuals in health, that it is not always easy to say in regard to any particular person how far his memory is defective. In other cases the degree of impairment is so great as to make its existence perfectly obvious. Between such extremes, all intermediate grades of defect may at times be met with. The nature and causes of the various defects of memory cannot possibly be set forth without giving some account of the different physiological processes involved in its exercise; and also of the several fundamental modes in which this is brought about.

The Component Processes in Memory.—What is commonly known as 'memory' is dependent upon two kinds of processes. The *first* of these is a vital, molecular, or organic process of some kind, taking place in various parts of the brain simultaneously, on the occurrence of some 'perceptive act' or thought-process. In a healthy and properly-nourished brain certain neural processes, in different regions of the organ, are supposed to coincide with each act of perception and apprehension. Similarly, in 'ideation' or reflection, molecular processes of a closely-related kind are presumed to take place, partly in the areas

of the brain concerned with perceptions and partly in other regions, and these several changes have the same kind of relation to our thoughts that the others have to our perceptions; in each case they, in fact, constitute the organic basis of the respective processes. These initial organic changes of all kinds were referred to by Laycock, and comprised under the name 'synesis.' The first essential, therefore, for the exercise of memory is that these synetic processes should have been properly accomplished. If they have been imperfectly performed, memory will be either defective or non-existent.

Yet these processes constitute the foundations for memory, rather than memory itself.

Memory essentially consists in a repetition or weak revival of such molecular movements and processes in nerve-tissues, and of the conscious states associated with them. They are similar in kind, and take place in all such parts of the brain as were concerned with the original conscious realisation of the objects, relations, or processes which now recur as 'remembered' impressions or thoughts. This, therefore, is the *second* of the processes above referred to, as essential to the exercise of memory.

Modes of Exercise of Memory.—The repetition or weak revival of foregone processes, and of their associated conscious states, is brought about in three modes fairly distinct from one another. The first mode of exercise of memory (*a*) is found in acts of perception, when, on the presentation of some object to the sense of sight, hearing, touch, smell, or taste, or to any two of them, the remaining qualities of this object become nascent or revived in memory, so that the object itself is perceived or recognised as being of such and such a nature.

This kind of process is only impaired where the nutrition of the brain as a whole is gravely interfered with. Special parts of such a process are, however, not unfrequently interfered with by local brain-disease, as when, for instance, the sight of a written or printed word does not rouse its appropriate related memories; or when a spoken word remains unrealised or unapprehended, because its mere sound does not excite all the memories which should cluster round it; in the one case we have what has been rather inappropriately termed 'word-blindness,' and in the other 'word-deafness.' The one set of persons exhibiting such defects may be perfectly well able to recognise natural objects or persons by sight; just as the others may be able to appreciate different kinds of natural sounds, or differences in emotional intonations of the voice, although particular words may not call to their mind any distinct apprehension of the thing, idea, or relation which they are usually employed to designate.

The second, or most common mode in which memory is exercised is (*b*) during the ordinary course of thought, when by natural processes of 'association' the ideas of objects, of persons, of events, and of their relations one with another and with ideas, recur to consciousness, with or without a simultaneous full realisation of the words suitable for the expression of all these phases of our thoughts—according as we are merely thinking to ourselves, or as we at the same time give expression to our thoughts whilst conversing with another person. These, together with the kinds of exercise first referred to, constitute by far the most frequent modes in which memory is called into play. It here manifests itself in a purely automatic manner, without sense of effort on our part (other than that which is concerned with the direction of our thoughts), owing to the fact that present cerebral activities tend to recur in the manner and order which have been most frequently repeated in the race and in the individual—such manner and order necessarily varying according to the particular direction and nature of their or his education, natural or acquired. The study of this order corresponds with the study of the order of mental phenomena, and has resulted in the establishment of certain so-called 'laws of association.'

The process by which language incorporates itself with all our perceptions and thoughts is not different from that which associates perceptions and thoughts among themselves. It is, however, a more special association; and consequently a weak or failing memory—whether resulting from old age, brain-shock, or malnutrition—is peculiarly apt to show itself in this direction, and that more especially by an inability to revive the cerebral processes connected with the names of persons, places, or things (*see* Aphasia). But this kind of defect has to be distinguished from the inability to utter or to write words which are nevertheless remembered, that is, where the cerebral processes associated with the word as a mental symbol may be revived, in the main, in some portions of the brain concerned with the reception of auditory impressions, though incitations may not be able to pass over from these centres so as to revive nerve-processes in other centres of the motor type, by which the word is either spoken or written, according as the one or other effect is desired (*see* Aphasia). The loss of verbal memory is in these latter cases not so real as it seems to be, and such defects may, moreover, be induced by quite limited cerebral lesions.

In the third mode of exercise of memory (*c*) there is no longer the easy flowing mechanical revival of foregone processes, together with the simultaneous recurrence of copies of foregone phases of consciousness, which should characterise the modes of exercise above alluded to. Now there is a delay in the process of automatic revival; a vague sense of effort intervenes at some stage of the thought-processes, similar to that of which we are conscious when we attempt to 'guide our thoughts' into particular channels; we strive 'by way of association' to find some new molecular channel by means of which the cerebral processes concerned with the forgotten name, event, idea, or relation, may be roused anew, in order that we may 'recollect,' or recall by voluntary effort, what may be needful for the continued expression of our thoughts.

This latter process of 'recollection' is, therefore, that which is rendered necessary by the first stage of faultiness of memory, a condition which may obviously be brought about in altogether different modes, to some of which we are now about to refer.

Ætiology of Defective Memory.—It seems clear, on the one hand, that for memory to be good (*a*) the preliminary process of synesis must have been well accomplished. Yet this first and essential condition may be defective from various causes. (1) The original plasticity or receptive potency of the nerve-tissue may have been inferior from birth; or it may have been temporarily lowered by conditions of mal-nutrition, such as are not unfrequently met with in persons who have suffered from severe fevers or from other exhausting diseases. On the other hand, the potency of the nerve-tissue may be good, and yet the processes of synesis may have been badly effected, owing (2) to the individual's lack of attention at the time when what is now to be remembered originally engaged his consciousness; for no truth is more obvious in regard to memory than that of its dependence upon the degree of attention bestowed upon the original impressions or ideas. Those which have been vividly attended to at the time, from whatever cause, tend to become indelibly 'stamped upon the memory,' and all the more so because such impressions or ideas are prone to be often thought of, and thereby strengthened by each revival of the cerebral process; whilst those that have slightly engaged our attention are apt not to be revived, and to be after a time effaced, though it is in this respect especially that so much of individual difference is met with. Greatly diminished power of attention is, moreover, commonly met with in exhausting diseases, and in multitudinous brain-affections.

But, on the other hand, however well the process of synesis may have been accomplished originally, this will be altogether unavailing if (*b*) the avenues are damaged or impaired by which associated processes transmit their stimuli. The automatic excitation of memory is then hindered. Thus, to take only one example, if certain commissural connections be severed between what we may term the visual and the auditory word-centres, a person may be able to read so as to understand the words which he sees, and yet not be able to pronounce one of them, because the associational stimulus cannot pass to the corresponding part of the auditory word-centre, so as to rouse this particular memory or idea of the word, from the molecular processes concerned with which the motor stimuli issue for its pronunciation. (See *Brain as an Organ of Mind*, p. 640.)

Again, however well the process of synesis may have been originally performed, if (*c*) the whole nutrition of the brain becomes lowered by exhausting disease or old age, failure of memory may present itself because attention cannot be adequately roused, and the cerebral processes generally are too feeble to propagate themselves, as they would have done formerly, into the various collateral channels or molecular paths, so as to rouse the activity of all such previously associated brain-regions as are necessary for the full realisation of the thoughts of the moment.

From what has been already said, it will be seen that defects of memory may result from very various causes, acting as an impediment to one or other of the successive processes upon which memory depends—namely, either (*a*) from synetic defects; (*b*) from associational defects; or (*c*) from expressional defects.

Pathology.—In all those cases in which we may presume that synesis is impaired, we may expect also to find evidence of a greatly weakened power of attention, and there may in addition be an impaired perceptive power. Such defects are mostly dependent upon general causes, affecting the nutrition of the brain as a whole. A condition of this kind may be only temporary, and then, whilst recent events are speedily forgotten, it may happen that the memory of old impressions remains fairly good, or may even be marvellously intensified, so that long-forgotten occurrences or knowledge become revived. At other times the patient's mind may for a time be reduced to a perfect blank, old and recent knowledge, familiar and unfamiliar, is alike blotted out; though after a time recovery of memory may take place, either slowly or with comparative suddenness. In cases of epileptic mania, and in many instances of brain-shock from blows upon the head, the patient may lose all memory of immediately preceding events.

Where the secondary process of revival is that which is interfered with, the loss of memory is generally most manifest in regard to words. The processes of association by which these are recalled to memory, are either impaired or disturbed, so that we get one or other variety of amnesia induced, either of the paralytic, or of the incoördinate type (*see* Aphasia). Such defects are, in the opinion of the writer, specially prone to be induced by lesions of the convolutions contiguous to the posterior extremity of the Sylvian fissure. (See *Brain as an Organ of Mind*, pp. 682–7.)

Where there is mere loss of power to express thoughts, the loss of memory is often more apparent than real, and is due to a mere paralysis affecting speech and writing as motor acts (*see* Aphasia). And these conditions, either singly or in combination, are also apt to be induced by lesions in the third left frontal convolution, or of regions between this gyrus and those bordering upon the posterior extremity of the Sylvian fissure.

Treatment.—The treatment of these various defects of memory, so far as they are amenable to therapeutic influence, naturally resolves itself into the treatment of the various general or local morbid conditions upon which they depend. In some cases we can do little or nothing; but in other instances much good may be effected under the influence of a tonic and restorative regimen, aided by stimulant, sedative, or hypnotic remedies. H. Charlton Bastian.

**MENIDROSIS** (*μὴν*, a month, and *ἱδρῶς*, sweat).—A term applied to vicarious menstruation by the skin. *See* Perspiration, Disorders of.

**MENIÈRE'S DISEASE.** *See* Vertigo.

**MENINGES, Diseases of.**—The treatment of this subject is naturally divisible into two main heads. We have to consider (1) the morbid conditions resulting from disease of the Cerebral Meninges; (2) those of the Spinal Meninges. Though most frequently affected separately,

still it happens on some occasions that these two main divisions of the membranes surrounding the great nerve-centres are simultaneously diseased. This is the case, for instance, in *Epidemic Cerebro-Spinal Meningitis*, an important general disease, which is considered in a separate article (*see* EPIDEMIC CEREBRO-SPINAL MENINGITIS). A similar diffusion of inflammation also occurs, but more rarely, in cases of *Sporadic Cerebro-Spinal Meningitis*, which may be sometimes 'simple,' and sometimes of the 'tubercular' order. In the articles that follow, the several diseases of the Cerebral Meninges and of the Spinal Meninges will be separately discussed.

**MENINGES, CEREBRAL, Diseases of.**—SYNON.: Fr. *Maladies des Meninges Cérébrales*; Ger. *Krankheiten der Hirnhäute.*—The following morbid conditions, and varieties of such conditions, have to be considered under this heading:—

1. *Inflammation*—of several varieties.
2. *Hæmorrhage into.*
3. *Hæmatoma of.*
4. *New growths* and *Adventitious products.*—Under this head are included, besides the different kind of tumours originating in the meninges, other bodies of quasi-accidental origin, which may be met with in the cavity of the arachnoid, in the meshes of the pia mater, or in connection with the vessels of these parts.
5. *Malformations. See* BRAIN, Malformations of.

Inflammation of the cerebral meninges occurs from various causes, and also affects various parts of the membranes, so that the subjoined varieties of the disease will have to be separately considered:—

*a. Simple Meningitis* { α. Idiopathic. β. Traumatic.

*b. Tubercular Meningitis.*

The simple meningitis of traumatic origin occurs under three pretty distinct forms, according as it affects the dura mater—*Pachymeningitis*; the surfaces of the arachnoid—*Arachnitis*; or the meshes of the pia mater beneath this membrane—*Leptomeningitis.* Both the *idiopathic simple meningitis* and *tubercular meningitis* are forms of leptomeningitis. All are acute diseases.

Concerning *chronic meningitis* we have more of pathological than of clinical knowledge, though even as regards the former side we are bound to say that much of the thickening and opacity of the arachnoid, formerly regarded as due to 'chronic inflammation,' is rather a mere result of degenerative overgrowth—partly brought about as an appanage of advancing age, and partly as a consequence of frequent or long-continued congestions. Still, such conditions may at times be coupled with more distinctive evidences of actual chronic inflammation, for example, in some cases of chronic mania, and also in general paralysis of the insane.

Good reasons, moreover, exist for believing in the frequent clinical existence of local chronic inflammation of the meninges, as evidenced by the presence more especially of localised pain and of tenderness on slight percussion, coupled with other head-symptoms. Fortunately for the patient, however, we have often no opportunity of verifying this diagnosis, because such a condition is of itself not likely to lead to fatal results. It may follow a blow; it may occur as one of the consequences of constitutional syphilis, or it may manifest itself independently of either of these causes. Chronic syphilitic meningitis is the best known of these varieties. Its associated morbid conditions are, however, most closely related to another set of changes, which will be described, and in which we have to do with new growths or 'gummata.'

Two other varieties of meningitis are occasionally met with as rare events; first, an inflammation limited to the envelopes of the cerebellum, or extending from it only to the pons varolii; and, secondly, an inflammatory condition of the lining membrane of the lateral, and perhaps the third ventricles. The natural history of these states is at present so little known as not to admit of systematic treatment. Their ætiology and symptomatology have still to be established. H. CHARLTON BASTIAN.

**MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.**—SYNON.: Simple Idiopathic Cerebral Leptomeningitis; *Leptomeningitis infantum* (in part). Fr. *Méningite Simple*; Ger. *Acute Hirnhautentzündung.*

DEFINITION.—A simple non-tubercular inflammation of the cerebral pia mater, which may be either limited to the convexity, general, or confined to the base of the brain. It is associated with very variable symptoms in different cases; and is probably caused in many different ways.

ÆTIOLOGY AND PATHOLOGY.—Our knowledge of the ætiology and pathology of acute idiopathic cerebral meningitis is only vague and indefinite, so that little but unconnected statements or mere suggestions can be here set down.

It appears that sex exercises an influence in the production of idiopathic meningitis, and that the disease occurs much more frequently in males than in females. In regard to age, it is met with almost as frequently in individuals from ten to twenty as in those below the tenth year. In individuals over twenty the disease is much more rare.

Meningitis is apt to occur during, or as a sequence of, some acute febrile disease, such as measles, scarlet fever, small-pox, and rheumatic fever. It may complicate erysipelas of the head and face; or may occur in the course of pneumonia or pleuro-pneumonia. Sometimes it is met with in miserably cachectic subjects, who have not previously been suffering from any acute disease. It has been known to follow prolonged exposure to the sun; to ensue after the occurrence of severe moral perturbations; and likewise to follow a shock or blow, even when this has not been complicated with an external wound, or with a fracture of one of the bones of the skull.

But how do these various predisposing or exciting causes operate, so as actually to bring about the inflammation of the meninges, with which we are now concerned? Here some hints only can be offered by way of explanation. In part the problem does not differ from that as to the actual cause of inflammation in other internal parts of the body. Setting aside traumatic influences, or the sudden operation of

excessive heat or excessive cold, how does inflammation start from mere altered nutritive processes? It is difficult to believe in a primary alteration in the mode of activity of cell-elements originating of and by itself, independently of altered nervous or of altered vascular conditions within the texture. Again, altered nervous influence (whether vaso-motor or other) *may* be a real factor in the initiation of a meningitis, even though we know nothing of it as a fact, and consequently can say nothing as to the kind or cause of altered nervous influence which might be operative. We are thrown back, therefore, necessarily upon a consideration of those altered influences that may arise in or upon the side of the vascular system, for the elucidation of the other probable cause or starting-point of the inflammation with which we may have to deal.

We shall do well to bear in mind, also, that in certain states of the system, or in certain constitutions, conditions exist (partly febrile, partly cachectic, and partly of the nature of blood-poisoning) which are inimical to the localisation of an inflammatory process (howsoever initiated), and just as favourable to its extension, especially in a tissue like that of the pia mater. And in just such conditions of the system we should also find that some simple accident on the side of the vascular system, such as the rupture of some vessel or vessels and the occurrence of a slight hæmorrhage into the tissue, or the occlusion of one or more vessels either by embolism or thrombosis (events which might not on other occasions lead to the setting up of anything like inflammation), may, under the particular constitutional conditions existing in the patient, be capable of exciting an inflammatory process.

1. In the acute diseases, or during convalescence from them, as well as in extremely cachectic subjects, altered blood-states sometimes exist favourable to the occurrence of thrombosis; and this may occur either in one of the veins returning blood to the longitudinal sinus, or in the sinus itself. The condition of the sinuses should therefore be always investigated in cases of meningitis. In many instances hæmorrhages have been found beneath the arachnoid in meningitis, and these may, like the meningitis itself, have been immediately consequent upon thrombosis in the longitudinal sinus, although this, the primary process, has escaped observation.

2. In erysipelas of the head and face, as a cause, we have the type of a mode of origin of meningitis such as may occur also in other cases —for example, in some of those instances where, in the course of rheumatic fever symptoms of meningitis (other than those which are occasioned by hyperpyrexia) set in with great severity, and cause the death of the patient just as rapidly as when they supervene in the course of erysipelas of the head and face. In both these cases no products of inflammation may be met with in the membranes *post mortem*, but only a very minute injection of the pia mater in all regions basal, as well as lateral, or vertical. The tendency here, therefore, is to set up a *general* meningitis, just as in the previous category of causes the tendency would be to the establishment of a meningitis affecting the convexity. On microscopical examination, in one such case, the writer found the minute vessels blocked with concretions of an albuminoid or fibrinous nature, which seem to have separated from the blood. (See *Path. Trans.* vol. xx. p. 8.)

It is difficult to say in what acute conditions some such cause as this may not have been operative in setting up the inflammation, where meningitis occurs in the absence of other easily recognisable causes.

3. Multiple embolisms of the vessels of the pia mater in certain cases of endocarditis are another possible initiating cause of idiopathic meningitis—which, moreover, seemed almost certainly to have been the actual cause, in a case that came under the writer's observation a few years ago.

4. Meningitis may take its origin in a slight lacerating lesion of the surface of the brain or of its membranes, with or without notable extravasation of blood, as a result of a fall or blow, even in cases where there is no fracture of the skull or external wound.

5. In other cases, also, a meningitis really secondary may appear to be primary and idiopathic, as when (*a*) it extends from some focus of syphilitic disease of the meninges, or (*b*) when it occurs as a sequence of some unrecognised chronic inflammation involving the middle ear and portions of the temporal bone.

Anatomical Characters.—Simple idiopathic inflammation of the cerebral meninges is a condition which varies much in severity in different cases. In its earliest or initial stage, nothing more than a minute and more or less uniform injection of small vessels and capillaries in certain regions of the cortex may be met with. But later on, definite products of inflammation are to be seen; these are for the most part situated beneath the arachnoid, in the meshes of the pia mater. They consist, according to the stage of the morbid process, either of a gelatinous white or yellow lymph-like matter, of actual pus, or of more coherent yellow lymph, in the form of membranous layers. In regard to the area involved considerable differences also exist. The inflammation—(1) may be limited to the convexity and to the lateral regions of both hemispheres; (2) it may be general, that is, involve the parts above-mentioned, and also the base; or (3) it may be limited to the basal regions of the brain. In both the latter cases the ventricles are apt to contain fluid, and the central parts of the brain to be softened, as they are in tubercular meningitis, which also affects the base in a special manner.

Of these varieties as to seat, the first, in which the convexity is involved, is decidedly the most typical, and in this respect simple idiopathic meningitis contrasts in a salient manner with tubercular meningitis, in which the tendency is no less marked to implicate the base of the brain. In the second variety, the inflammation beginning above probably extends to the base by mere continuity, in cases where the condition of the patient, or the intensity of the inflammatory process itself, favours its spread from the original site; or, in certain cases, the inflammation may be from the first general in seat. In regard to the third variety,

much doubt may be said to exist. It is by no means clearly established that a simple idiopathic inflammation ever begins to manifest itself at the base, and there only—though no good reason can be assigned why such a distribution should not occasionally exist, except that experience shows it to be at least very rare. If, moreover, such an inflammation be not of unsuspected traumatic origin, there are still two other modes of accounting for its existence, which should be excluded before regarding it as an idiopathic cerebral meningitis of unusual site. Thus, it may be an extension upwards from the spinal meninges of an inflammation beginning there—a case, in fact, of cerebro-spinal meningitis, either sporadic or epidemic. Or, on the other hand, it may be one of those cases of tubercular meningitis where the general disease manifests itself on the side of the brain first, and in which the patient dies before the local process is at all fully developed. In such a case the inflammation may be really of the tubercular variety, and yet to superficial observation not recognisable as such. Although not likely to occur often when the autopsy is made by a competent observer, the case may be otherwise, and either of such misapprehensions as to the real nature of the affection is more especially apt to occur where the head only is examined.

In all these cases, too, the inflammation may be limited to the meninges themselves, or the surface of the brain may also be manifestly involved in the inflammatory process, so that we then have to do with a *meningo-cerebritis* of varying seat and extent.

Symptoms.—In no disease is the symptomatology more various than it is in acute meningitis—a fact partly due to the varying intensity of the inflammatory process, partly dependent upon the process being localised or more general, and partly according as there is or is not the co-existence of dropsy of the ventricles with inflammation of their walls. Sometimes the disease is almost latent, accompanied only with slight symptoms, merging into stupor and coma a day or two before death. Or the symptoms may be marked and quite tragic in their severity; ushered in either by frightful pains in the head, by well-marked delirium, or by convulsions; subsiding eventually into a condition of stupor or coma; and followed by death within eight or ten days, though this may be delayed till the expiration of three weeks or a month. Recovery, which sometimes occurs, must be regarded as a rare event.

Inasmuch as it is not practicable, within the limits of this article, to give a detailed account of the various groupings of symptoms that may be met with in different cases, we must confine ourselves to an enumeration of the symptoms themselves, most apt to occur—(1) in the early stages of the disease, and (2) in its later phases.

1. Cephalalgia of an intense character, either general, or localised in some particular region or regions of the head, may be complained of again and again where the patient is old enough, or, if he be too young, is indicated by cries, by application of the hands to the head, or by other signs. Sometimes, however, this symptom may be almost absent, or it may come on at a later date. Delirium, occasionally furious, at other times more quiet and of a simply loquacious type, is another symptom; or extreme restlessness. Mere insomnia, too, sometimes exists from the commencement; whilst at other times a semi-comatose condition, gradually deepening into actual coma, may exist from the first, especially in children, or it may succeed a transitory delirious condition. Nausea and vomiting, and also convulsions, either local or general, may be met with in the early stages of the disease, and sometimes as initial symptoms. With them will go general pyrexia and sometimes rigors; also heat of head, rapid pulse, a furred and often thickly-coated tongue, constipation, perhaps some intolerance of light and of loud sounds, together with an easily obtainable *tâche cérébrale*.

2. As later symptoms we may have localised convulsions, or spasms, often of the tonic order, affecting perhaps the head and neck, which are frequently drawn backwards, or one or both arms; or a condition of trismus may exist. The eyes, too, are sometimes drawn upwards. The pupils may be at first contracted, or if not, they may be of medium size, unequal and insensitive; whilst later on they are most frequently widely dilated and insensitive. The conjunctivæ are often injected. Paralysis of one arm, or sometimes of an arm and a leg, may occur. The sensibility of the skin may be either exalted or deadened. The abdomen is often hollow and boat-shaped. The tongue becomes thickly coated, or dry and brown. Difficulty of deglutition is frequently well marked towards the end; and there is incontinence of fæces and urine as soon as the stupor becomes marked. Sometimes the pulse is unnaturally slow and infrequent from the first; at other times, and especially towards the end, it is very frequent and irregular. The respiration, too, becomes much disturbed, being often sighing and of very irregular rhythm, tending to become stertorous at last. The temperature is frequently high, but pursues a markedly irregular course. Remissions of the pyrexial condition may take place from time to time. The skin is generally hot and dry, though occasionally there may be copious sweats. Stupor and coma almost invariably occur at the last, if not present at an earlier stage.

Prognosis.—A large number of deaths take place within the first week of acute meningitis; a much smaller number survive till the end of the second week; fewer still reach the end of the third; and only a very few survive to the fourth week. It is difficult to say what the percentage of recoveries may be; but probably less than ten would survive out of a hundred cases of acute idiopathic cerebral meningitis.

Diagnosis.—The diagnosis of idiopathic meningitis involves considerations very similar to those arising in the diagnosis of tubercular meningitis, and need not therefore now be discussed. *See* Meninges, Cerebral, Inflammation of, Tubercular.

The diagnosis of simple from tubercular meningitis must oftentimes be a matter of extreme difficulty. Whether the condition of the blood, as recognised by the aid of the microscope, is the same in simple meningitis as it is in tubercular

meningitis the writer is unable to say. Should it not be so, some help might be obtained in this direction. The conditions under which the disease seems to develop may throw some light upon the problem. In regard to special symptoms, the possible range is so great in each variety, that it becomes difficult to fix upon any that are positively distinctive of one or of the other. Delirium is, however, rarely so violent in tubercular as it may be in simple meningitis. Retraction of the head is also not so frequent in the tubercular variety. On the other hand the temperature much more frequently rises over 101° Fh. in simple than it does in tubercular meningitis. Finally, it must be borne in mind that the former is an extremely rare disease, the latter unfortunately only too common; and that whilst in tubercular meningitis the two sexes fall victims with about equal frequency, in the simple variety, two out of three are likely to be males.

Treatment.—In the early stages of acute simple meningitis aperients may be freely administered. A leech or two might be applied to the temples, in cases where pain is greatly complained of; or under the same conditions the head may be shaved and an ice-bag applied, should it not be deemed useless on account of the extreme restlessness of the patient. The writer believes that little or nothing is to be expected from drug treatment towards the cure of this disease, although some alleviation of the more distressing symptoms may at times be brought about by special attention to them. The patient requires to be carefully fed, and assiduously nursed and kept quiet throughout, in the hope that the end may be favourable.

H. Charlton Bastian.

**MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.**—Several distinct forms of meningitis, of traumatic origin, have to be carefully distinguished from each other. We have a meningitis in which the outer surface of the dura mater is the part chiefly affected—*Pachymeningitis*; one in which the cavity of the arachnoid is the seat of the effusion—*Arachnitis*; and one in which both these escape, and the subarachnoid spaces, or, it may be, the structure of the pia mater, is primarily involved—*Leptomeningitis* or *Subarachnoid Meningitis*. For the most part, it is possible to distinguish these forms at the bedside, as well as in the post-mortem room. Sometimes the case is of a mixed form; especially is it not uncommon for an inflammation which had begun between dura mater and bone to extend through the fibrous membrane, and involve the arachnoid beneath it; but it is still a remarkable fact in pathology that very frequently the delicate arachnoid suffices to restrict an extensive inflammatory process to one or the other side of it.

Of the inflammation between the dura mater and bone it is possibly true that it occurs only in association with disease of the bone. If there be any exceptions to this latter statement they occur probably in connection with syphilis. Occasionally cases are met with in which the arachnoid cavity itself contains puro-lymph, the surface of one hemisphere, for instance, being covered, and yet there is no history of injury or of prior inflammation of the scalp or bone. Such cases are, however, rare, and their possible causes need further investigation.

In a general way, children may be deemed more liable to meningitis after injuries than adults, and in them not very unfrequently severe and fatal complications ensue after injuries not attended by fracture.

1. **Pachymeningitis.**—Inflammation of the meninges secondary to inflammation of the bone is one of the commonest of the dangers which attach to injuries to the head. The bone is contused, and in most cases there is some stripping off of the pericranium.

Symptoms.—For a week or ten days the patient does well; and then he begins perhaps to complain of headache, feels chilly and uncomfortable, and cannot eat. These symptoms increase, and drowsiness and semi-stupor may come on. If the ophthalmoscope be used, very possibly at this stage the discs may be found hazy and swollen; and this may occur without any evident defect of sight, or with but little. If the trephine be now used, the bone will be found discoloured, its diploe greenish, and beneath it a collection of pus. The pus is rarely in large quantity, and is usually discoloured, whilst all around the collection of fluid there is much coherent and sticky lymph, which loosens the membrane from the bone. It is very rare to find a large abscess, such as those described in the celebrated cases given by Pott. Usually the termination of such cases is that the substance of the dura mater inflames; that the arachnoid is implicated; and that a layer of puro-lymph lines that membrane, and coats the hemisphere. With this state special symptoms are associated, the most noteworthy being hemiplegia of the opposite side. Very commonly, however, another event cuts short the case. In mentioning the early symptoms nothing has been said as to rigors, nor do they, as a rule, occur, unless the complication just hinted at is developed. That complication is pyæmia. This pyæmia has no essential connection with the meningitis. It depends upon the inflammation of bone, which is the common cause of both, and which may be the parent of either singly, or of the two as twins. With the gangrenous osteitis occurs gangrenous phlebitis of the veins of the diploe; from these the process extends to the proximal sinus of the brain (more commonly the superior longitudinal); infective emboli of decomposing material gain access to the circulation; and all the well-known phenomena of pyæmia follow. It is most important to distinguish the symptoms which belong to the pyæmia, if we would rightly estimate those due to the meningitis, for very frequently they are met with together. Especially must we remember that a severe rigor probably denotes pyæmia; and that, if it be repeated, the diagnosis of this affection is almost certain. It is the almost constant complication with phlebitic pyæmia, which so almost invariably disappoints the surgeon of any benefit from the use of the trephine in this group of cases. If pyæmia does not occur, then probably arachnitis is there, and thus it comes to pass that a recovery after secondary trephining is almost unknown.

Treatment.—But little is to be done as

regards treatment for this form of osteitic meningitis; the main thing is to adopt measures for its prevention. The careful management of the wound, either by Lister's plan or by the constant use of the lead and spirit lotion, and the exemption of the patient from all risk of contagion, are the matters which will chiefly claim attention. In cases of depressed compound fracture without symptoms, one of the objects of primary trephining is to prevent meningitis, by removing displaced fragments, and by affording free exit for secretions.

2. **Arachnitis.** — The form of meningitis to which the term arachnitis is applicable is a frequent consequence both of inflammation of contused bone and of wounds of the membranes. Enough has already been said as to the circumstances under which it occurs after contusions of bone, and we have chiefly now to examine its pathology and special symptoms.

Anatomical Characters. — In the *post-mortem* room arachnitis may be easily distinguished from inflammation in the subarachnoid spaces, and the distinction ought always to be carefully made. In arachnitis the puro-lymph covers the cerebral convolutions in an even layer, and does not dip into the sulci, to which, indeed, it has no access; whereas when the spaces are affected, the sulci are filled, and the convexities of the convolutions remain free. In the latter none of the effusion can be peeled or sponged away, nor does any adhere to the parietal arachnoid. In true arachnitis both the parietal and visceral layers are smeared over.

Symptoms.—Many cases of compound fracture of the skull, with laceration of the dura mater, afford us good opportunities for the study of acute traumatic arachnitis; but, unfortunately, in many of these cases the brain-substance is also punctured, and it becomes at least possible that the condition described as diffuse encephalitis may be present, and may complicate the symptoms. We are helped, however, as regards the avoidance of fallacious inferences by the other set of arachnitis cases, in which the arachnitis is secondary to osteitis, in which, there having been no injury to the brain, there is no probability of encephalitis. Speaking, then, from the result of observation of both classes, it may be stated that whenever evidences of arachnitis are found widely spread over a whole hemisphere, there has been during life hemiplegia of the opposite limbs. Exceptions, apparent or real, occur to this, but they are rare, and probably most of them are apparent and not real. The risk of error lies in the case in which, in a patient who is very ill, hemiplegia, which supervened gradually during the last day or two of life, may have been overlooked. The hemiplegia is rarely complete, and unless the limbs be carefully tested at each visit, both patient and surgeon may be unaware of its presence. Its degree is proportionate to the extent of the arachnitis; and if the latter pass under the falx and involve the opposite hemisphere also, there may be general weakness of all the limbs, which may again to some extent mask the hemiplegia. It is almost certain that the hemiplegia has little or nothing to do with pressure from effused fluid, for the latter is rarely in large quantity. Its immediate cause is, indeed, not very obvious, but as the grey matter of the cortex is almost always discoloured, and changed from a pink tint to a greenish-slate hue, it may be conjectured that this in some way has to do with the symptoms. The other symptoms which attend acute diffuse arachnitis are—wandering delirium, rarely violent; increased temperature; incontinence of urine and fæces (part of the hemiplegia); and occasionally unilateral sweating. It should be remarked that the hemiplegia involves both sensation and motion. As, however, it is incomplete, the defect in sensation is almost certain to escape notice. Patients who are obliged to admit that they cannot move their limbs forcibly, will deny that there is any defect in feeling, and it is often impossible to confute them. In well-pronounced cases, however, sensation always fails as well as motion.

Treatment.—It is doubtful whether recovery ever takes place after this form of arachnitis has become well established; and here, again, we have to think rather of prevention than of cure. Cold to the head—spirit lotions being the most convenient form—and very early and efficient resort to mercury, are the chief measures where the dura mater is known to have been lacerated. Strong spirit lotions should be used from the first, and mercury also given. It is too late to commence the exhibition of mercury after the symptoms of arachnitis have set in. Amongst the measures of treatment of more doubtful value are aconite, in small doses frequently repeated, leeches, blisters, and fomentations. If blisters are used, they should be applied to the neck, or back, or shoulder.

3. **Leptomeningitis.**— This form of traumatic meningitis, which occurs in the subarachnoid spaces, is an exceedingly interesting malady.

Ætiology.—Leptomeningitis may be encountered after any form of injury to the skull involving laceration or puncture of the visceral arachnoid, but its most typical illustrations are witnessed after fracture through the petrous portion of the temporal bone. This fracture, although usually counting as a simple one, is in reality compound, in that it opens up access to an air-containing cavity. It is possible that air may reach the injured bone either through the external ear or the Eustachian tube.

It is a matter of some interest to determine whether arachnitis of these spaces often, if ever, results from severe concussion without any fracture, or after simple fracture without any possibility of admission of air. It is impossible, however, to speak clearly on this point.

Anatomical Characters.—Results which are scarcely ever witnessed after simple fractures in other regions of the skull may occur here, a fact which can only be explained on the supposition that we have to encounter the risks incident to compound lesions. Amongst the results referred to is the frequent development, some days after the accident, of inflammation in the large subarachnoid spaces at the base of the brain. It is probable that the inflammatory process travels along the course of the nerve-trunks (seventh nerve), and thus gains access to the spaces. Affecting first the parts adjacent

to the roots of the nerves, the inflammation may spread downwards on the medulla and cord, or upwards through the posterior fissures into the ventricles, or over the surface of the hemispheres. Usually it is almost confined to the base of the brain and medulla oblongata. These parts are coated with serous lymph, which invests them closely and adheres to all the nerve-roots passing from them. The layers of arachnoid which cover in and confine the exudation remain quite transparent, and show no traces of lymph on their inner surface. It is only when these layers are cut or torn that access to the inflammatory effusion is gained. In performing the autopsy it is needful to use care lest this laceration be made by accident, and the characteristic appearance somewhat spoiled.

Symptoms.—Patients suffering from this form of basal subarachnoid inflammation may become delirious and die very quickly in the first access of the morbid action; but, on the other hand, and more usually, they may live for several days, or a week or two, and show only comparatively mild symptoms. Absolute sleeplessness, with occasional wandering, but without any degree of paralysis, was the most prominent symptom in one very well-marked case. It is probable, though not as yet established, that optic neuritis often attends this form of meningitis. Its peculiarities as regards increase of temperature have not as yet been ascertained. That the subarachnoid spaces are affected may be plausibly suspected whenever, after supposed injury to the base of the skull, vague cerebral symptoms, unattended by definite paralysis, supervene; and if there have been bleeding from the ear and deafness, with facial paralysis in the first instance—a triad pathognomonic of fractured petrous bone—then this is the form of meningitis certain to follow, if any.

Prognosis.—As regards recovery from traumatic meningitis of the base, what has been said on the difficulties in forming a confident opinion as to its presence will sufficiently explain the impossibility, in any given case in which recovery has resulted, of feeling sure that the inflammation in question had really existed. Many patients, however, recover more or less, often perfectly, after prolonged and severe symptoms following fractured base. Some of these are doubtless recoveries from severe contusion, but others, especially those in which serous fluid has drained away from the ear, may be plausibly conjectured to be recoveries from meningitis of the base.

Treatment.—The measures of treatment likely to conduce to recovery in such cases are the same as those for other forms of meningitis. Mercury to ptyalism is the chief agent, and so impressed has the writer for long been as to the danger of the malady, and the value and harmlessness of the drug, that he has been in the habit of giving it from the first in all cases in which fracture of the petrous bone has been diagnosed. Jonathan Hutchinson.

**MENINGES, CEREBRAL, Inflammation of, Tubercular.**—Synon.: Granular Meningitis; Acute Hydrocephalus; *Hydrocephalus internus*; Brain Fever (in part); Tubercular Leptomeningitis; Fr. *Fièvre cérébrale; Méningite granuleuse; Méningite tuberculeuse*; Ger. *Tuberculöse Hirnhautentzündung.*

Definition.—An acute and extremely fatal febrile disease, with a predominance of head-symptoms; terminating in stupor and coma, with or without convulsions; and characterised after death by a 'granular' meningitis affecting the pia mater at the base of the brain, with the frequent accompaniment of dropsy of the lateral ventricles, and softening of the parts around them. The inflammation of the membranes at the base of the brain is often found to be associated with a spinal meningitis.

Tubercular meningitis is not an independent affection; it constitutes one important phase of a many-sided general disease commonly known as Acute Tuberculosis, and marked anatomically by the presence of 'grey granulations' within the thorax and abdomen, as well as in the membranes of the brain. In certain rare cases death takes place from granular meningitis, before the anatomical marks of the general disease have had time to develop within the chest or abdomen. More frequently, however, the manifestations of the general disease are already well developed in one or other, or in both, of these situations, at the time that they reveal themselves also on the side of the brain. In the latter, and by far the most common class of cases, the symptoms met with will be in part those of the general affection, and in part (but in a predominant degree) those due to that implication of the brain and its membranes with which we are now specially concerned. *See* Tuberculosis, Acute.

Ætiology.—The ætiology of tubercular meningitis of course resolves itself into the ætiology of the general disease, acute tuberculosis, of which it forms part.

This affection is one which occurs with special frequency in young children, between two and six years old, though it is also met with in infants, in older children, in young adults, and even in persons beyond middle age. In adults it is most apt to manifest itself as an occasional complication in the course of chronic phthisis. In children a proclivity to the disease seems often to be inherited, so that two or more in the same family may be carried off by it. But in what proportion of cases any such proclivity exists can scarcely be said to be known.

The central brain-changes—namely, the dropsy and the central softening—are not, in the opinion of the writer, necessary accompaniments of tubercular meningitis, although they most frequently coexist—just as they are also most frequently concomitants of simple or non-tubercular meningitis when it affects the base of the brain. These central brain-changes were, however, the part of the disease that first attracted the attention of physicians, so that the affection with which we are now concerned was known as *Acute Hydrocephalus* long before the more modern designations of *Granular* or *Tubercular Meningitis* came into use.

Anatomical Characters.—When the calvaria is removed the dura mater is found to be tightly stretched over the brain. On stripping back this membrane, the arachnoid presents a dull appear-

ance, and it is slightly sticky when touched. The convolutions of the vertex and lateral regions of the brain are seen to be more or less flattened from pressure, and the sulci are correspondingly indistinct. No lymph may be seen; or at most a small quantity, in the lower parietal regions along some of the branches of the middle cerebral arteries. When the brain is removed, however, and its under surface is examined, a more or less opaque white or a yellowish lymph-like matter may be seen (beneath the arachnoid, in the meshes of the pia mater) extending from the optic commissure backwards over the central portions of the base and onwards over the pons. In certain cases lymph and evidences of recent inflammation are found round the medulla, and even along the whole length of the spinal cord. More or less lymph also extends on each side into the sylvian fissures. A minute inspection will likewise show that the tip of the temporo-sphenoidal lobe, and the orbital surface of the frontal lobe, are flecked with a number of translucent granulations, as though the parts had been sprinkled with fine sand; and on opening up the Sylvian fissure on each side, similar granulations, with others more opaque and of larger size, may be seen amongst the lymph in this situation. Translucent granulations also sometimes exist, scattered more sparingly over the lateral aspects of the hemispheres, especially along the sides of the vessels.

Examination with the microscope shows that the granulations are composed of overgrowths of tissue-elements immediately surrounding the smaller vessels, and within their perivascular sheaths. In these situations the tissue overgrowths may cause a local bulging of the sheath, either all round, or merely on one side of the vessel; and when such growths become opaque from incipient fatty degeneration, they are then more easily visible as minute white specks. A close examination of the prolongations of the pia mater dipping between the convolutions, with the aid of lens or microscope, will often show minute granulations not otherwise recognisable—and that, too, in many regions of the brain. And in cases of incipient tubercular meningitis, where the amount of lymph about the base is extremely slight, the lens or microscope may show the presence of granulations, not otherwise recognisable, in and around the lower part of the Sylvian fissures—that is in the regions where they are most prone first to manifest themselves.

The pia mater is generally unduly adherent to the surface of the convolutions, so that it can only be removed in small shreds, and then not without tearing the superficial grey matter. This condition of things is the very opposite of what may be met with in some cases of simple meningitis affecting the vertex, in which the thickened pia mater, with all its prolongations, may sometimes be easily stripped off from the greater portion of a hemisphere in one piece.

The substance of the brain is commonly much more vascular than natural. The lateral ventricles are usually moderately dilated, containing from 2 to 4 or 6 ounces of not very clear serum. The veins on their surface are then engorged, and the fornix and other adjacent parts may be more or less softened, or actually diffluent. Microscopical examination of such softened tissue will reveal the presence of an abundance of granulation-corpuscles; and its specific gravity, if estimated, will be found to be diminished—both these characteristics being marks of a pathological softening which has occurred during life, and not of a softening due to mere *post-mortem* maceration. Some have erroneously supposed that such mere maceration would be adequate to produce the softening.

Sometimes the above-described changes are more fully developed in one than in the other hemisphere; and occasionally also in some parts of the brain small nodular growths of a 'tubercular' nature may be met with, varying in size from a small pea to an almond. These growths are most apt to occur in the substance of some of the cerebral convolutions, or near the surface of the cerebellum, or even, as the writer has seen, within the substance of the corpus striatum. In many such cases the small nodular tumours will be found to be in intimate relations with the vessels of the part, and, in fact, to be composed of a mere aggregate of the smaller 'granulations' more or less fused into a single mass.

Pathology.—The granulations begin to appear first in the meninges of the base under those influences, whatever they may be, that lead to the development of similar grey granulations in other organs of the body. These primary changes excite a common inflammation of the membranes around, and thus entail the production of the lymph, which covers the base of the brain, and extends on either side into the Sylvian fissures. Why the grey granulations should tend to develop first, and specially about the vessels at the base of the brain, cannot at present be explained.

This inflammation of the basal meninges also extends, by direct continuity of tissue, over and around the cerebral peduncles to the velum interpositum, and to the connective tissue at the upper and anterior extremity of the middle lobe of the cerebellum. In one or other, and often in both, situations the tissues are thickened by lymph. The writer has seen the velum interpositum thick and leather-like in consistence, and the venæ magnæ Galeni which run through it blocked by thrombosis; and this he believes to be an occasional cause of the central softening and dropsy, previously referred to as component parts of the disease (see *Edinburgh Medical Journal*, April 1867). In other cases, where no such thickening or thrombosis is to be detected, there is great swelling of the connective tissue, from development of lymph, opposite the termination of these great veins which return the blood from the surface of the ventricles and from the central parts of the brain—at the point, that is, where the veins of Galen empty themselves into the straight sinus.

In this way the very common association of the central ventricular changes with the basal meningitis may be accounted for, and also the occasional absence of such changes, in instances where the inflammation, apt to be set up through mere continuity of tissue, does not attain sufficient proportions to interfere with the return of blood,

either through the veins of Galen, or from them into the straight sinus. It is of course possible that the central softening may also be favoured by an independent affection of the small vessels situated in the walls of the ventricles, and a development of granulations around them—though this has not hitherto been recognised. It is, however, well known that thrombosis is extremely apt to occur in those minute vessels in various parts of the brain which are enveloped by granulations—a fact that goes far to account for the extreme gravity of the symptoms in many cases of tubercular meningitis, in which naked-eye changes appear to be slight and altogether disproportionate in amount.

Symptoms.—The symptoms presented in different cases of tubercular meningitis often vary very widely from one another, although amongst them all there is an underlying bond of similarity. The variation may be easily understood from a consideration of the fact that such symptoms form part of those pertaining to a febrile affection characterised by other local manifestations, of varying importance in different cases; and also from the fact of the differences constantly met with in the relative and absolute development of the different kinds of changes encountered within the cranium itself in this disease—especially in regard to the amount of ventricular effusion and central softening existing in conjunction with the meningeal inflammation, which itself varies much in intensity and in regard to the area involved in different cases.

It is, therefore, usual and most convenient to enumerate the possible signs and symptoms of this disease as they occur in three stages—artificial and often ill-marked from one another as they are—namely, (1) those of the *invasion stage*; (2) those of the *developed disease*; and (3) those of its *closing phases*.

(1) *Stage of Invasion.*—Amongst the initial symptoms of tubercular meningitis may be mentioned obstinate and recurrent vomiting, often associated with constipation; coming on frequently after a period of previous malaise; and associated with fretfulness, slight wasting, indisposition to play, and disturbed sleep. Soon after, or simultaneously, there may be more or less marked indications of cephalalgia. Young children who cannot speak are fretful and constantly cry; they often also put their hands to their head. Such children start and cry out in their sleep. The temperature may be as yet scarcely, if at all elevated; or there may be rigors from time to time, with temporary feverishness, recurring daily about the same hour. The child often cries out when touched, and a more or less general exalted sensibility to painful impressions seems to exist.

(2) *Developed Disease.*—In the second stage any feverishness that may have existed often abates. There may be less restlessness, so that the child even sleeps more than natural. The pupils are often insensitive to light, and unequal. There is frequently also some slight or perhaps marked strabismus. The pulse is apt to be much less frequent than natural (56–70 per minute perhaps), and decidedly irregular. The hypersensitiveness of skin may have disappeared, but a peculiar vaso-motor irritability exists, so that when the nail of the fore-finger is drawn once across the skin of the abdomen or other part, a deep red linear mark comes out slowly, and persists a long time. This so-called 'tache cérébrale,' whilst also met with in other affections, is, as Trousseau rightly enough insists, rarely absent in tubercular meningitis. Frequent plaintive cries may be uttered, though the child is generally more quiet and drowsy; it is apathetic also in regard to food, not asking or crying for it, but still taking it, perhaps well, whenever it is administered. Convulsions may occur during this stage, or weakness of one or more limbs may be noticed, especially where larger tubercular nodules occur in one or other portion of the brain-substance. Sometimes, too, the paralysis is of a shifting and transitory nature, varying in degree or even in situation in the course of a few days.

(3) *Closing Phases.*—In the closing stages of the disease the drowsiness may gradually deepen into stupor or actual coma; though in conditions short of the latter, the child may still more or less frequently utter plaintive cries. The pulse, instead of being less frequent than natural, now becomes preternaturally frequent; whilst the respiration often assumes a slow, sighing, and markedly irregular type. The face, frequently pale and clammy, flushes at times. The head is hot, and the temperature generally raised, though often not more than to 100°, and rarely beyond 102°, until quite to the close of the disease. The fontanelle is raised, and there may be unnatural pulsation. The eyes, when examined with the ophthalmoscope, may show evidences of grey granulations in the choroid. The pupils may be unequal, but are generally dilated and insensitive. In one remarkable case the writer has seen a rhythmical contraction and dilatation go on, especially on exposing them to light. In this stage, when the patient is sufficiently conscious, it may be found that sight is notably impaired or almost lost.

The patient may take the food which is given, up to the last; though at other times there seems to be an actual inability to swallow it, even when it is placed in the mouth, owing to paralysis of the muscles of the tongue and pharynx. The abdomen is often boat-shaped and retracted; and an obstinate constipation still continues. Even in this last stage of the disease a temporary and delusive lull may take place; the child may seem to revive a little, but only too soon to lapse again into a state as bad as or even worse than before. Frequent and long-continued convulsive seizures are especially apt to occur during this stage of the disease; and death may take place during or immediately after one of these attacks. At other times the end is brought about more gradually, through progressing failure in the heart's action, combined with disturbance of respiration. In the latter class of cases the temperature may gradually fall, during the last few hours before death takes place, to several degrees below the normal; though in other cases of tubercular meningitis there is a slow and steady rise of temperature up to 105°, or even 106°, before the patient expires.

Diagnosis.—In the early stages the diagnosis of tubercular meningitis may present extreme difficulties. We must wait, before expressing a

definite opinion in one of these doubtful cases, till the patient has been seen and examined two or three times. The premonitory symptoms and those of the first stage are often far from distinctive. They may, it is true, represent the beginning of tubercular meningitis, but, on the other hand, they may also represent something less serious—for instance, a mere failure of health from various causes, complicated by some gastro-intestinal irritation, or perhaps the commencing outbreak of some one or other of the specific fevers. Details as to the child's condition during the last two or three weeks, comprising the order of evolution of the several symptoms, may, however, throw some light upon the real nature of the case at an early stage of the disease.

A contributory cause of the difficulties besetting the early diagnosis of tubercular meningitis is to be found in the fact that acute tuberculosis is itself extremely difficult to recognise. We cannot, therefore, readily fall back upon a diagnosis of the general condition in order to strengthen our diagnosis of tubercular meningitis. As a matter of fact it is just the reverse. Of all the local manifestations of this disease, those within the head produce by far the most definite set of symptoms; so that we can always most safely infer the probable existence of acute tuberculosis with grey granulations throughout the body, from the presence of the developed symptoms of tubercular meningitis. The symptoms produced by grey granulations within the thorax or within the abdomen, are far less distinctive or, in fact, not distinctive at all. The existence of a particular habit or build of body in all cases of acute tuberculosis to any appreciable extent, or certainly to such an extent as to make it possible to use the recognition of it as an aid to diagnosis in a case otherwise obscure, is very improbable. Our notions as to the existence and nature of a tubercular habit of body need revision; it must not thoughtlessly be confounded with the mere phthisical habit of body; and it seems probable, from more than one point of view, that acute tuberculosis is a quasi-accidental disease, occurring at times in individuals of any build of body whatsoever—with no more limitations, that is, than may exist in regard to the incidence upon persons of different bodily types of one of the common acute specific diseases.

The symptoms of the established disease are therefore alone distinctive, to any really trustworthy extent, of the existence of tubercular meningitis, and through it of the presence of its general underlying condition. We may have our suspicions before, but these can only transform themselves into certainties as the disease actually develops, and as it passes, moreover, into the incurable stage.

At this phasis of the disease the alternative conditions to be thought of are in the main these—typhoid fever on the one hand, or else some form of intracranial disease other than tubercular meningitis. Here, as in almost all cases of brain-disease, we have to look not to any one or two signs or symptoms which can be regarded as pathognomonic, but rather to the sum total of symptoms, and to the way in which they are grouped. With the possible existence of some or all of the premonitory and initial symptoms already enumerated, if the patient becomes more somnolent; if the pulse falls much below par in frequency, and is at the same time irregular; if with a condition of fever still existing, the child does not constantly crave for drink; and especially if there is also the combination of obstinate constipation and a retracted abdomen, together with an irregular and suspirious form of respiration, we may feel more and more certain that we have not to do with even one of the most anomalous forms of typhoid fever associated with head-symptoms—or, indeed, with any form of intracranial disease other than tubercular meningitis. An examination of the temperature chart may considerably aid us in the same direction, and so also may a microscopical examination of the blood.

Some years ago, the writer made observations upon this latter point, tending to show that in tubercular meningitis there are, in a large proportion of the cases, distinctive alterations in the blood—as drawn by a needle-prick from the tip of the fore-finger and examined at once upon an ordinary microscope-slide—capable of affording very material aid in the diagnosis of tubercular meningitis from typhoid fever, as well as from other brain-affections (such as a new-growth implicating the pons and contiguous parts, thrombosis in some of the cranial sinuses, or perhaps one of the simple forms of meningitis). The characters of the blood met with in tubercular meningitis are these:—The white corpuscles are decidedly more numerous than natural, and speedily (that is, within ten to fifteen minutes after the blood has been drawn) show signs of great amœboid activity, by the development of vacuoles within them, and of numerous projections from their outer surface; groups of protoplasmic particles of various sizes are also to be seen interspersed amongst the blood-corpuscles, as well as here and there a small pigment-granule or an irregular block of pigment of reddish or reddish-black colour. The red corpuscles usually run together into irregular masses, rather than into definite rouleaux, though they present no very distinctive changes. This increase in number with exalted amœboid activity of white corpuscles, in conjunction with the other blood-characters above-mentioned, are not met with in typhoid fever, or in the great majority, at least, of other cerebral affections.

For the diagnosis of tubercular from the simple form of meningitis, *see* MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.

PROGNOSIS.—Death is well-nigh certain within three weeks, or at most a month, from the date of the invasion-symptoms of tubercular meningitis. When the disease has arrived at a stage permitting of pretty certain diagnosis, hope rather than rational expectation may still hold out a chance of recovery. Although instances of this have occurred, they are of extreme rarity. If the course of the disease is to be modified by treatment, it must be during those early stages when we are capable of forming only a provisional or tentative diagnosis. In these stages, however, the writer—and many good observers share this opinion—is inclined to think that under judicious treatment the development of the disease may

be arrested. Still this view may, quite possibly, be an erroneous one. Proof of such a position, or of its opposite, is, from the nature of the case, impossible.

Treatment.—From what has just been said, it will be seen that anything like curative treatment must be directed to the early or premonitory symptoms of the disease. Here the writer thinks he has seen decidedly good results from one to six grains of iodide of potassium, according to the age of the child, administered three times a day, with small doses of cod-liver oil; at the same time attending to the state of the bowels, and giving suitable doses of bromide of potassium at night, till the restless condition with disturbed sleep has passed away.

When the disease is further advanced, we may perhaps be able to diminish pain by the application of cold to the head; but we only aggravate the sufferings of the patient by the use of blisters, tartar emetic ointment, or other irritating applications. Bromide of potassium may do something to keep convulsions in check, though at other times it seems to be quite powerless. Chloral is probably a dangerous drug for a patient, the action of whose heart is already so seriously interfered with; though chloroform inhalations may be had recourse to in an extreme case, where persistent convulsions cannot otherwise be checked. Beyond this, the child needs the most careful nursing, and to be well supported with strong beef-tea and milk, and occasionally with stimulants, so long as it is capable of taking food, whilst attention is paid to the bowels. In this way, if the patient's case is to prove one of those rare and exceptional instances in which recovery is possible, we, at all events do nothing to thwart the course of natural processes which have a chance, however small, of terminating in recovery.

H. Charlton Bastian.

**MENINGES, CEREBRAL, Hæmorrhage into.**—Synon.: Fr. *Apoplexie meningée*; *Hémorrhagie méningée*; Ger. *Hirnhautblutungen.*

Definition.—Effusion of blood in one or other of the following situations:—(1) Between the bone and the dura mater; (2) Between the dura mater and the arachnoid (into the so-called 'arachnoid sac'); or (3) beneath the arachnoid and into the meshes of the pia mater.

Ætiology.—The first of these varieties of meningeal hæmorrhage has an almost exclusively traumatic origin; being a result of falls or blows which occasion the rupture of one of the meningeal arteries, lying between the bone and the dura mater. Still, caries of the bone may in very rare cases lead to such a hæmorrhage, by causing erosion of one of the meningeal arteries.

The other two varieties are not so distinctly separated from one another, since a hæmorrhage occurring in the pia mater, if large, is very apt to break through the arachnoid, and thus lead to effusion of blood into the 'arachnoid sac'; and this whether the primary effusion has been the result of a traumatic injury, or is a sequela of some general or local disease. Effusion into the arachnoid may also occur as a result of rupture of some vessel on the inner surface of the dura mater; this being probably a rare consequence of injury, though it is a frequent result of disease in this situation (*pachymeningitis interna*).

Effusions of blood are occasionally found beneath the arachnoid which have not originated there, but which have come to the surface, by laceration of brain-substance, from some intracerebral hæmorrhage; or they may have been caused by intraventricular hæmorrhages, finding their way into the fourth ventricle, and thence into the sub-arachnoid tissue.

In very young children, whose vessels are presumably healthy, bleeding into the arachnoid may occur from any unusual amount of strain. This occasionally takes place at the time of birth, especially during prolonged labours. Indeed, according to Cruveilhier, arachnoid hæmorrhage is the cause of the death of about one-third of those infants who die almost immediately after birth. A little later on in life, a similar accident may occur during paroxysms of whooping-cough, or during other spasmodic respiratory conditions, in which the return of venous blood from the head is impeded. Later still, an arachnoid hæmorrhage not unfrequently follows a fall or blow upon the head, or it may result from the rupture of an aneurism on one of the larger vessels about the base of the brain—especially the basilar or one of the middle cerebrals. Small subarachoid hæmorrhages, often multiple, are not unfrequently produced by the occurrence of thrombosis in the longitudinal sinus. They may also occur in persons suffering from scurvy or leucocythemia. Lastly, they may be met with as one out of the many forms of lesion occurring in men suffering from general paralysis of the insane.

Meningeal hæmorrhages are decidedly more common in males than in females—in the proportion of about three to one. They do not, like cerebral hæmorrhages, occur with progressive frequency as age advances, but are much more uniformly distributed through the different decades of life.

Anatomical Characters.—When death takes place soon after blood has been effused into the arachnoid, as well as in the other situations, it is found in an easily recognisable condition. This is by no means the case, however, after the lapse of months or years; then, in the case of small hæmorrhages, we may meet with mere yellowish or rust-coloured stains; whilst where they have been of larger size, we may meet with decolorised cyst-like bodies, either free or adherent—or else there may be decolorised membranous masses, adhering mostly to the parietal arachnoid. Where the size of the clot has been large, the surface of the brain is more or less pressed upon, so that some atrophy of its substance follows. Many of these latter points are well exemplified in a case recorded by Dr. Quain in the *Path. Trans.*, vol. vi. page 8.

Sometimes the layers of altered blood are neither adherent to the arachnoid, nor do they lie free on its surface; they may be attached to the surface of the dura mater, or lie between new growths arising from its inner layers, and thus produce a condition which often goes by the name of *hæmatoma*. Prolonged discussions have taken place on the question whether these changes are results of a primary hæmorrhage, or whether

we have not rather to do with a *pachymeningitis interna hæmorrhagica*, where an inflammation is the first event, during which effusion of blood takes place into the innermost layers of the altered and inflamed membrane. *See* MENINGES, CEREBRAL, Hæmatoma of.

SYMPTOMS.—The symptoms attendant upon meningeal hæmorrhage will necessarily vary a great deal in severity, according to the amount and suddenness of the effusion. These symptoms are, moreover, in the great majority of the traumatic cases obscured by those depending upon the mere shock and concussion of the brain, which the original accident or blow occasions.

Where subarachnoid hæmorrhages occur in the course of thrombosis of the longitudinal sinus, no distinctive symptoms are as a rule produced; and those of the primary affection are themselves only too variable, and difficult of recognition. Again, where subarachnoid hæmorrhages occur in the course of purpura, leukæmia, or allied affections, the amount of blood effused is usually too small to produce definite or recognisable symptoms. At most, the abrupt onset of pain in the head, vertigo, or mental confusion, may give rise to a suspicion that such an event has occurred.

Where a large hæmorrhage takes place beneath and into the arachnoid sac, over one hemisphere, or over both, either as the result of a fall or blow, or from the bursting of an aneurism on one of the large arteries at the base of the brain, a profound coma is produced which may prove rapidly fatal—that is, in the course of a few minutes or a few hours. Where the amount of blood effused is less, and where it is poured out more gradually at first, there may be premonitory symptoms, in the form of sudden headache, vertigo, mental confusion, vomiting, or convulsions, rapidly followed by unconsciousness. At first there is generally complete relaxation of all the limbs; but later—after some hours or days—the weakness may be distinctly unilateral, that is, of hemiplegic type—though sometimes with very slight implication of the face. There may also be twitchings or rigidity of the limbs on one or both sides. On recovery of consciousness there may be no distinct loss of sensibility, only numbness, in the limbs; and the paralysis may after a time grow less up to a certain point, or gradually disappear.

DIAGNOSIS.—In many of the slighter forms of hæmorrhage into the cerebral meninges diagnosis is, for the reasons specified, almost impossible.

In the more severe cases a sudden apoplectic attack is produced, agreeing very closely with that occasioned by some of the most serious forms of intra-cerebral hæmorrhage. Causal conditions, especially when they have been traumatic, together with the possible youth of the patient, may in some cases help us to diagnose a large arachnoid hæmorrhage, from a copious bleeding into the lateral ventricles, or from a sudden hæmorrhage into the middle of the pons Varolii; though it should be borne in mind that in the former of these two conditions the pupils are almost always widely dilated, whilst in the latter they are as constantly contracted and insensitive, whereas they are likely, so far as the writer's observations have gone, to be in a more intermediate condition in arachnoid hæmorrhage.

PROGNOSIS.—In the case of arachnoid hæmorrhages, whether large or of only moderate volume, should the patient survive the first effects of the effusion, and, it may be, of the injury which caused it, danger to life is no longer to be feared. The only question, then, is as to the amount of paralysis, mental impairment, or of irritability with cephalalgia, which may remain; or whether or not a tendency to convulsions may be set up, as a consequence of the original injury and lesion.

TREATMENT.—The treatment of a case of meningeal hæmorrhage does not differ from that appropriate for cerebral hæmorrhage. Perfect rest in the recumbent position, with the head slightly raised, is essential. Cold to the head may be conjoined with hot applications and mustard plasters to the lower extremities. For other indications and details of treatment we must be guided by the varying conditions of the patient. During convalescence in the more favourable cases we must pay great attention to the general health of the patient, and above all protect him from overwork or excitement of any kind.

H. CHARLTON BASTIAN.

**MENINGES, CEREBRAL, Hæmatoma of.**—SYNON.: *Pachymeningitis interna hæmorrhagica*; Fr. *Pachyméningite*; Ger. *Pachymeningitis.*

DEFINITION.—Inflammation of the inner surface of the dura mater, attended with the formation of a membranous vascular tissue, into which hæmorrhage takes place.

ÆTIOLOGY.—This affection is met with at all ages, but is most common in advanced life and early childhood. Males are said to suffer more frequently than females. It is rarely primary; most of the recorded cases have followed, at some interval, an injury, or occurred in the subjects of insanity, or chronic alcoholism. Other cases have appeared consequent on acute rheumatism and other pyrexial affections, especially pneumonia and small-pox.

ANATOMICAL CHARACTERS.—According to Virchow, in the early stage, before hæmorrhage has taken place, a delicate reticulated membrane exists on the inner surface of the dura mater in one or many layers—even twenty. It varies in consistence according to its age. The colour is usually reddish, from the number of new-formed vessels; but it is often rust-coloured from degenerated blood extravasated in minute quantity. The position of the membrane is always over the convexity, commonly near the middle line; and it is often symmetrical on the two sides. In the second stage, that of hæmorrhage, blood in considerable quantity is effused between the layers in one or several places, and may extend as far as the limits of the false membrane, thus constituting one or more simple or loculated cysts. These cysts are, of course, adherent externally to the dura mater, and internally rest on the arachnoid membrane and convolutions, which they compress and even depress. Their contents are blood—liquid, coagulated, or in every stage of degeneration. Ultimately only coloured

serosity may remain. The thin delicate wall of the cyst was formerly regarded as organised fibrin from a blood-clot, or as the separated parietal layer of the arachnoid; and some pathologists are still of opinion that the hæmorrhage precedes the formation of the membrane. *See* MENINGES, CEREBRAL, Hæmorrhage into.

SYMPTOMS.—Two periods may often be recognised, corresponding to the anatomical stages of hæmatoma of the dura mater just described. In the first, circumscribed headache is the chief symptom, often felt at the vertex. It may be associated with giddiness, uncertainty of movement, lowered mental power, and contraction of pupils. In children, in whom the whole disease commonly lasts only a few days, there is often fever. In adults this stage may last for weeks or months. The second stage, that of blood-effusion, is attended by an increase of the mental dulness to distinct somnolence, at first intermitting, but deepening to actual coma with a rapidity that depends on the rapidity of effusion. The pupils continue contracted, but that on the side of the mischief may become the smaller. Hemiplegic paralysis or contraction may occur when the hæmatoma is unilateral. In children convulsions are common. The duration of this stage in the adult may be weeks or months; and death occurs in coma. In children it usually lasts only a few days.

DIAGNOSIS.—The diagnosis of hæmatoma of the dura mater is often difficult, and depends on the slow onset of coma, after a period of headache, without symptoms to indicate a localised lesion of the brain. In the child the disease may be mistaken for tubercular meningitis, but the course of infantile hæmatoma is usually more rapid, vomiting is rare, and muscular contractions and convulsions are common.

PROGNOSIS.—The prognosis is very unfavourable, but not absolutely fatal in the adult; in several cases in which the symptoms of hæmatoma have been present, recovery has taken place. In children there is little hope.

TREATMENT.—In the child one or two leeches may be applied behind the ears: and cold to the head, and counter-irritation to the skin of the neck and limbs, are likely to be useful.

In the adult, if by rest, cold to the head, and counter-irritation the effusion can be arrested, absorption of the blood will slowly take place; and this may be furthered by moderate purgation, by diuresis, as well as, perhaps, by the administration of iodide of potassium.

W. R. GOWERS.

**MENINGES, CEREBRAL, New Growths and Adventitious Products in.**—The clinical aspects of the several pathological conditions composing the set of changes included under these heads, are comparatively meagre and ill-defined, as compared with what we know of them pathologically. For this various reasons exist, some of which will be presently indicated.

ANATOMICAL CHARACTERS. — In the present article it will suffice to enumerate the new growths and adventitious products met with in the cerebral meninges, referring to special articles on the several bodies for a fuller description of them.

SYMPTOMS AND DIAGNOSIS.—Intracranial new growths or adventitious products are, as a class, accompanied by the most diverse sets of symptoms. The new growths or products vary in different cases within very wide limits, from the point of view of the suddenness of their onset or increase, as well as of their actual bulk or number, and also as regards the particular intracranial region or regions which they implicate. We may therefore in some measure understand what happens, that some growths or products may be unaccompanied by appreciable symptoms during life; that others may be associated only with vague symptoms of a general order, denoting the existence of some kind of intracranial mischief; whilst, on the other hand, some may be associated with such comparatively definite groups of symptoms as to make it reasonably easy to arrive at a pretty certain diagnosis, both as to the situation and as to the nature of the intracranial growth or morbid product.

But, it may be said, why use the broader term 'intracranial' when we are here only concerned with morbid conditions of the meninges? This brings us to the second of the reasons above referred to, namely, that it is often, and, for the most part, impossible to distinguish clinically between mere meningeal new growths or products, and those which arise from or within some portions of the encephalon. The reasons for our impotency in this direction are also not difficult to find. First, we may cite the general one, of the frequent vagueness or even absence of any appreciable symptoms attendant upon intracranial growths or products; and, secondly, the more special reason, that growths starting from the meninges will often press upon and implicate the surface of the brain in different regions, in much the same manner as if they sprang from the surface of the brain itself in such regions. And, thirdly, there is the further consideration that intracranial growths or products are frequently multiple in the same individual, and then may partly spring from the meninges, and partly in the substance of the brain itself.

For these various reasons it happens that if the diagnosis of a purely meningeal new growth or adventitious product could ever be arrived at, it would be effected through the medium of a previous pathological diagnosis. But how limited are the possibilities in this direction may be gathered from the following considerations. Certain personal or family characteristics presented by a patient may make it highly probable that syphilitic intracranial disease, or that scrofulous intracranial growths exist. Still more rarely the signs and symptoms may indicate that cancerous intracranial growths, or that growths similar to some multiple tumours already existing in other parts of the body, may be the causes also of co-existing head-symptoms. Yet these are almost the only cases in which it may be possible for us to arrive at anything like a positive diagnosis as to the nature of a supposed intracranial growth or product. And of these the first only, namely, syphilitic disease, could with any degree of certainty be diagnosed

as a change limited to the meninges; the others would be just as likely to take origin within the cerebral substance as from the meninges.

For these reasons no good purpose would be attained by entering at length into the groups of symptoms that may be produced by meningeal growths or adventitious products. They are apt closely to resemble some of those co-existing with growths within the brain, which have been already considered. *See* BRAIN, Tumours and New Growths of.

A. **New Growths.**—(*a*) *Syphilitic growths or thickenings of the meninges.*—These products are met with principally in the form of yellowish lymph-like masses, connecting the dura mater to the arachnoid, and this with the pia mater to the surface of the cerebral hemispheres in some region (often the parietal), of irregular area and variable extent. This yellow 'gummatous' material probably takes its origin, for the most part, in or on the surface of the dura mater, while it may extend inwardly so as to infiltrate or press upon the surface of the brain, and also outwardly, so as to cause erosion of the cranial bones. The membranes around may be thickened, or more or less obviously inflamed. This form of disease does not occur in congenital syphilis; when it exists, therefore, it is invariably met with in persons beyond the age of puberty. Similar growths taking origin completely within the brain-substance are extremely rare.

(*b*) *Scrofulous tumours.*—These are often spoken of as 'tubercular' growths. They, unlike the last, are much more frequently met with in children than in adults, and especially in young children between the ages of two and seven years. They are yellowish nodular masses, varying in size from a small pea to a walnut. Whilst some of them may obviously spring from the pia mater, others (and this much more frequently) are met with within the substance of some portion of the cerebrum or cerebellum. As in the last case, these growths are presumed to be in the main dependent upon the existence of a special constitutional state—one which carries with it proclivities to certain kinds of tissue over-growth.

(*c*) *Cancer.*—Cancer not unfrequently affects the dura mater, whence it may extend outwards or inwards, and thus implicate other parts secondarily—either eroding and perforating the bone, or greatly depressing the surface of the brain as it grows inwards. Although more frequent in the second half of life, meningeal cancer may occur also in youth, or even in childhood.

(*d*) *Other growths.*—Other growths of less frequent occurrence, and therefore of less importance, also start from the meninges. We may have the following:—*Sarcomata; Fibromata; Fibro-enchondromata; Steatomatous or cholesteatomatous growths;* and *Structureless or wax-like tumours*, having the so-called 'amyloid' reaction. Such tumours as these may give rise to more or less definite head-symptoms during life. They spring, for the most part, from the dura mater rather than from the arachnoid.

Other smaller, and mostly rare, growths may be met with quite unexpectedly after death, because of their occurrence in the form of flat plates, which do not interfere by pressure or otherwise with the subjacent cerebral substance, and therefore give rise to no obvious symptoms. They are:—*Osteomata*, which occur either in the falx, in the walls of the lateral sinuses, or much more rarely in the substance of the arachnoid, in the form of osseous plaques; and *Calcareous depositions* (belonging, perhaps, more strictly to the next than to this section) which vary in size from a mustard seed to a small nut, and which may be found in or beneath the arachnoid, or also on the inner surface of the dura mater. Sometimes a number of such minute concretions may be met with in connection with the pia mater or arachnoid (especially when these membranes are thickened or otherwise diseased), in the form of minute granules closely resembling the so-called 'brain sand,' each of which may present traces of several concentric layers.

B. **Adventitious Products.**—(*a*) *Parasites.* These may be of two kinds, both of them being larval states of tape-worms.

*Cysticerci* are larval conditions of *Tænia solium*, having the form of small bladders, which vary in size from that of a pea to a horse-bean. They often exist in large numbers in the meninges, and within the brain of the same individual, and are very rarely solitary. As many as 100 may be found within the cranium; and when they are thus numerous many of them will almost certainly be met with in the pia mater, merely pressing upon and slightly indenting the surface of the convolutions, though others will be situated within the substance of both cerebral and cerebellar convolutions. They are not confined to persons of any age or either sex, though they occur rather more frequently in those representing the second than the first half of life. Infection is brought about by the eating of raw, or insufficiently cooked 'measly' pork. *See* CYSTICERCUS.

*Hydatids* are larval forms of *Tænia echinococcus*, a very small four-jointed tape-worm commonly infesting the alimentary canal of the dog. The hydatids met with in the brain are always barren cysts (acephalocysts), and the outer enclosing membrane is generally very thin. They are usually solitary; may vary in size from that of a marble up to a large orange; are rare even in the brain-substance, and still more rare in the pia mater. Sometimes two, three, or more hydatid cysts exist within the cranium of the same individual, but they are then usually of small size. Davaine refers to an instance in which many hydatids were found in the meninges and at the surface of the brain, as well as within its substance. Out of twenty-four recorded cases, in which the age was stated, the writer has found that no less than eighteen of them were persons between the ages of ten and thirty years, three of the remainder being above and three below these extremes. Infection may well be brought about by means of the dog's tongue, which is at times only too quickly transferred from parts liable to be contaminated by ova of its own tape-worms, to the hands or even the lips of his master or mistress. Besides this more direct method, the ova of the Tænia echinococcus voided by the dog may be blown about, or otherwise get by accidental means into water or food taken by man. *See* HYDATIDS.

(*b*) *Aneurisms.*—These, situated either on one

of the vessels composing the circle of Willis, or on some one or more of its primary branches, may vary in size from a small pea to that of a walnut. Those of larger size, which are usually single, may give rise to distinct head-symptoms; but at other times, and especially when the aneurism is very small, there may have been no reason to suspect its existence, or that of any other intracranial disease, till, perhaps, the rupture of such an aneurism may lead to the supervention of serious symptoms, speedily terminating in death. These aneurisms may occur, possibly as a sequence of a previous embolism (Church), even in early youth as in adult age.

(*c*) *Thrombi in the cerebral sinuses.*—The process of thrombosis is known principally as it occurs in three of the sinuses contained within the cerebral meninges, namely, in the longitudinal sinus, or in one or other of the two lateral sinuses.

(1) The formation of a thrombus in the *longitudinal* sinus is usually a *primary* phenomenon, dependent in the main upon the operation of general causes, such as some alteration in the quality of the blood, combined with slow, feeble, and irregular action of the heart. The operation of these causes has, however, been known to have been favoured in certain cases by local conditions, such as the great development of Pacchionian bodies, and their projection into the sinus—an event most likely to occur in elderly persons. Thrombosis of the longitudinal sinus may, however, be met with also in the early as well as in the middle periods of life. The original thrombus frequently prolongs itself through the straight sinus to the 'torcular Herophili,' and thence on either side into the lateral sinuses. And in this latter class of cases ventricular effusions and superficial cerebral softenings are apt to be associated with the thrombosis. The softenings are of a peculiar and characteristic kind, consisting generally of a number of small red patches, occupying principally the grey matter on each side of the upper surface of the brain. Occasionally softening of a portion of brain of considerable extent has been produced. Besides the ventricular effusion, there may also be an excess of serum beneath the arachnoid, or more rarely small effusions of blood in these situations, together with minute patches of hæmorrhage in the convolutional grey matter, such as have been described by Cruveilhier under the name of *apoplexie capillaire*. The actual combination of these conditions will depend upon the seat of the obstruction, the rapidity with which it is brought about, and the existence or not of marked pathological conditions of the vessels generally. The variation in the symptomatology of this affection in different cases is, therefore, also extreme; the symptoms are sometimes of an excessively grave order, and sometimes almost *nil*. Strange as it may seem, Dr. Gee says:—'I have known a decolorised softening thrombus to occupy the whole bore of the upper longitudinal sinus, to be attended by large sub-arachnoid hæmorrhages, and to have caused no symptoms during life.'

(2) Just as frequent, however, as the event above referred to, is the formation of a thrombus in one or other of the *lateral* sinuses; only then the process is almost invariably *secondary* to inflammation of the scalp or cranial bones, whether induced by traumatic conditions or by disease. Caries of the cranial bones is the principal predisposing condition; indeed, in three-fourths of the recorded cases the temporal bone was the part affected, and that as a result of internal otitis. In these cases there is often evidence of a more or less circumscribed inflammation of the meninges, but cerebral softenings and subarachnoid extravasations of blood rarely occur. This, according to Von Dusch, is explicable by the fact that in these cases the thrombosis starts from the veins in communication with the inflamed spot, and reaches the lateral sinus only after the collateral circulation has had time to establish itself; instead of forming primarily in the sinus, and before a collateral circulation has been set up.

(*d*) *Serum.*—This fluid may be met with in excess in two situations. It occurs (1) *beneath* the arachnoid, in cases in which one or both cerebral hemispheres have become wasted or atrophied. After fifty or sixty years of age, therefore, it is common to find an excess of subarachnoid serum. This fluid transudes from the vessels as pressure outside them diminishes, owing to brain-atrophy. It is absurd to suppose that it has any other, or at least any important, pathological significance. To speak, as some do, of 'serous apoplexy' as a cause of death, when no very obvious reason can by such persons be assigned for it, is a mischievous assumption of knowledge where a confession of ignorance would be better. But serum is sometimes found in excess (2) *within* the cavity of the arachnoid, when it constitutes the condition occasionally spoken of as 'external hydrocephalus.' It seems probable that the majority of such cases are instances in which the fluid of an ordinary internal hydrocephalus has, at some period before or after death, in part escaped from the ventricles into the cavity of the arachnoid (*see* Hydrocephalus, Chronic). Still, there may be a narrow margin of cases not capable of being thus accounted for, in which the cause of the presence of fluid in this situation is very uncertain, when it is not, as it may be sometimes, an appanage of meningeal inflammation.

Prognosis.—Some of the smaller and more slowly growing tumours may give rise to no symptoms during life, and may not appreciably tend to shorten its duration. The accumulation of serum beneath the arachnoid is, moreover, only a non-disturbing effect of other causes.

The case is, however, of much graver import where we have to do with syphilitic, scrofulous, cancerous, or other growths having a tendency to more or less rapid increase; also where the patient is suffering from the existence of intracranial cysticerci or hydatids, or from the occurrence of thrombosis in the longitudinal or lateral sinuses. In all such instances we may, for the most part, look for a steady increase in the gravity of the patient's symptoms, and, except in the case of the first kind of growth under the influence of proper treatment, for death at no very distant date.

Treatment.—Drug treatment can be looked forward to as curative, or nearly so, in only one

of these various maladies, namely, in that of syphilitic origin—hence the great importance of a correct diagnosis where this condition is present. In a large number of cases, symptoms of the gravest character, associated, it may be, with paralysis, stupor, severe convulsions, excruciating cephalalgia, and even incipient insanity, one or more, or all, will, when really of syphilitic origin, yield in a truly marvellous manner to the continued and steady use of iodide of potassium in doses of eight grains, gradually raised to twenty or thirty grains, three times a day, especially when given in combination with $\frac{1}{32}$ to $\frac{1}{16}$ of a grain of bichloride of mercury.

Cod-liver oil, with vinum ferri or the syrupus ferri phosphatis, together with good food, quietude, and fresh air, may also do something to retard or even stop the growth of scrofulous tumours in sickly children.

Beyond this, in the class of cases which we have just been considering, medicinal treatment can be merely palliative. We must strive to relieve headache and secure better sleep; to mitigate the severity of convulsive attacks; or, if possible, to lessen the marked tendency to vomiting which may exist. Mental dulness and stupor, in such cases, are mostly beyond the reach of relief from therapeutics; though restlessness and irritability may perhaps be mitigated, by the administration of remedies suitable for the relief of pain, and for the encouragement of sleep.

H. Charlton Bastian.

**MENINGES, SPINAL, Diseases of.**—In this place we shall have to consider the following conditions:—

1. *Inflammation* of several varieties.
2. *Hæmorrhage into.*
3. *New growths* and *Adventitious Products.*
4. *Malformations.* *See* Spina Bifida.

Inflammation affects the spinal meninges in several different forms, though they are divisible into two main categories. Thus we may have:—(*a*) *Inflammation* of the spinal meninges of *traumatic* or *secondary* origin; and affecting either the dura mater (spinal pachymeningitis); or the arachnoid membrane (spinal arachnitis). (*b*) *Inflammation* of the spinal meninges of a *simple idiopathic*, or of a *tubercular* nature, and both of them affecting the pia mater (spinal leptomeningitis).

These different forms of spinal meningitis, whether existing alone or in association with a similar inflammation of the cerebral meninges, occur as acute diseases. Occasionally, where such diseases do not terminate fatally, they may lapse into a sub-acute or chronic condition, and thus persist for a considerable time. In association with new growths or with adventitious products in the meninges there may also arise a sub-acute or chronic localised inflammation of these membranes; but of chronic spinal meningitis beginning idiopathically as such, and pursuing a course chronic from the first, our knowledge is at present extremely slight. Chronic thickenings of the spinal membranes are, it is true, met with from time to time *post mortem*, which are by some deemed to have had an inflammatory origin independently of any acute attack. But as in other situations, so here considerable thickenings of these serous membranes may be met with as a result of degenerative rather than of inflammatory changes; and such conditions may give rise to no very appreciable symptoms during life till, as a sequence of their thickening and undue adhesion to the surface of the spinal cord, a superficial or annular form of scelerosis becomes established in this organ, either limited in site or irregularly developed in different regions.

1. **Meninges, Spinal, Inflammation of, Traumatic and Secondary.**—Ætiology.—In the case of the cerebral meninges, inflammation as a result of traumatic injuries is more common than as a phenomenon secondary to disease of the bone or of the scalp. The proportional frequency of these modes of causation is, however, somewhat reversed in the case of the spinal meninges; partly because the head is more liable than the spine to suffer from direct injuries, and partly because disease of the spine and of adjacent parts occurs with considerable frequency in such a manner as to be capable of exciting a secondary inflammation of the spinal meninges. Among the various efficient *traumatic* influences may be mentioned fractures and dislocations of the vertebræ, and stabs or other penetrating wounds implicating the contents of the spinal canal; whilst among the most frequent morbid conditions, in the course of which there may be a *secondary* development of spinal meningitis, we must cite the following:—caries of the vertebræ, deep sloughing bed-sores in the sacral region; cancer of the vertebræ; and inflammation of some part of the thoracic or abdominal parietes contiguous to the spinal column, and capable of spreading to the spinal canal from within.

Anatomical Characters.—In all these cases the signs and products of inflammation may be found in one or other, or in both, of two situations; that is, either implicating the dura mater, principally on its external surface, when we have the condition commonly known as *spinal pachymeningitis*; or affecting the surface of the arachnoid so as to produce a *spinal arachnitis*. Thus the same kind of limitation in the distribution of the inflammation is apt to occur when it starts under the influence of such causes, as is found to obtain in regard to the traumatic or secondary inflammations of the cerebral meninges. Perhaps there is in the case of inflammation of the spinal membranes, however, a rather more distinct tendency for such inflammations to spread, so as to involve the subjacent pia mater, than is the case in the parallel inflammations of the cerebral meninges.

In *spinal pachymeningitis* the dura mater itself is thickened and more vascular than natural, this being seen more especially on its outer surface; and both it and the surrounding connective tissue are covered or infiltrated either with yellowish lymph-like matter, or with actual pus. The internal surface of the dura mater may also be more or less covered with inflammatory products. The nerve-roots passing through the membrane are likewise generally affected by the inflammatory process, and they may show signs

of compression or even of atrophy. Such inflammation may be either limited to the region of two or three vertebræ, or it may affect more or less the whole length of the spinal membranes.

Another more idiopathic and also more chronic form of spinal pachymeningitis has of late been observed by Charcot and others, affecting principally the inner layers of the dura mater in the cervical region. In this condition, which is described by the author above named as *pachyméningite cervicale hypertrophique*, there seems to be a considerable hyperplasia of tissue-elements in the inner layers of the dura mater, which is apt to develop into an overgrowth of almost cicatricial hardness, often made up of concentric laminæ. These are frequently adherent to the arachnoid and to the pia mater, which also become more or less thickened. In these latter cases especially, not only are the spinal nerve-roots greatly damaged, but the spinal cord is itself more or less compressed and softened, so that distinct paralytic symptoms, with muscular atrophy, are apt to be produced.

Where *spinal arachnitis* is superadded, or when it exists alone, we find that pus or lymph is situated on the outer surface of the visceral arachnoid, and also to a less extent on that lining the dura mater. The combination of the two conditions is rather more frequent than the existence of arachnitis alone, and it is important to remember that these forms of inflammation are very rarely, if ever, primary and idiopathic, with the exception of the more chronic variety described by Charcot, but that they occur as consequences of injury or of certain forms of disease adjacent to the spinal canal.

Symptoms, Prognosis, and Treatment.—As the nerve-roots are affected in these forms of inflammation, as well as in the idiopathic meningitis which implicates the pia mater (*Spinal leptomeningitis*), and as the symptoms of both sets of affections are in great part dependent upon this, and are therefore in many respects similar (and by no means always capable of being accurately discriminated from one another), it would serve no useful purpose to dwell upon the symptomatology and treatment of spinal pachymeningitis and arachnitis alone. The reader is, therefore, referred to the corresponding sections in the next article.

**1a. Meninges, Spinal, Inflammation of, Simple Idiopathic and Tubercular.**—Synon.: *Simple and Tubercular Spinal Leptomeningitis.*

Simple spinal meningitis of idiopathic origin, and tubercular spinal meningitis, are affections so closely related to one another, both in their clinical and pathological aspects, that no advantage whatsoever would be derived from considering them separately. In each case we have to do with an inflammation involving the spinal pia mater, so that the products of inflammation are situated beneath the arachnoid membrane. In order to distinguish these from other forms of meningitis, such as pachymeningitis and arachnitis, it is desirable that we should use some special term, such as *leptomeningitis*, which has of late been employed as a distinctive appellation for an inflammation affecting the pia mater, whether cerebral or spinal.

In regard to the extent or area of this kind of inflammation, it must be said that the tubercular variety always involves the presence of a similar inflammation at the base of the brain, though the contrary position is not true—that is to say, the tubercular inflammation may exist at the base of the brain alone, without involving the spinal meninges. Of the non-tubercular forms of spinal leptomeningitis, there are two varieties, and of these one form always involves the membranes at the base of the brain and the spinal meninges simultaneously. This is the 'epidemic cerebro-spinal meningitis,' which is described in a separate article (*see* Epidemic Cerebro-Spinal Meningitis). The other form may or may not simultaneously involve the membranes at the base of the brain, so that we have in these cases either a 'simple sporadic cerebro-spinal meningitis,' or a 'simple spinal meningitis.'

Whenever the inflammation has a 'cerebro-spinal' distribution, no confusion is involved by retaining the use of the simpler term meningitis, as it is generally understood that forms of inflammation having such a distribution involve the pia mater especially. But in place of the name spinal meningitis, if we mean to imply that the inflammation affects the same tissue, it is best to use the more special and distinctive term 'spinal leptomeningitis.'

From what has been said above, it will be understood that the symptoms resulting from meningitis involving the base of the brain alone, or together with serous effusion and softening of the walls of the ventricles (which, as we have seen, so frequently co-exists with inflammation of the membranes in this situation), have been principally studied in the purely cerebral forms of tubercular meningitis. On the other hand, the symptoms resulting from spinal leptomeningitis are best studied in the simple forms of this disease. It will also be evident that the simple and the tubercular forms of cerebro-spinal meningitis are likely to agree to some extent in their symptomatology with that of the disease known as 'epidemic cerebro-spinal meningitis.'

Ætiology.—This disease is most prone to occur in children and in young persons; and is more frequent in males than in females. Persons who are badly fed, and live under very unfavourable sanitary conditions, are more liable to be attacked than those who are healthy and surrounded by opposite conditions.

For the tubercular form the exciting causes are all such influences or conditions, whatever they may be, which determine the outbreak of acute tuberculosis. The affection of the spinal meninges may be either an extension of the inflammation originally existing at the base of the brain alone, or it may be another independent manifestation of the general disease developing within the spinal canal simultaneously with the cerebral meningitis. *See* Meninges, Cerebral, Tubercular Inflammation of.

For the simple or non-tubercular form, the exciting causes are various, but the best established of them would seem to be these:—exposure to cold, or cold and wet, in various forms; certain acute diseases, or the period of

convalescence therefrom; concussion of the spine, as from falling down stairs, or in other ways; wounds affecting the spinal cord or its membranes, as in stabs of various kinds; or fracture and dislocation of the vertebræ.

The last modes of causation mentioned are similar to those which obtain for spinal pachymeningitis and arachnitis. For, although these latter conditions may be excited alone under such traumatic influences, they may also in certain cases, and especially arachnitis, be excited in association with a spinal leptomeningitis. Precisely the same kind of thing has also to be said in regard to the occasional action of other causes, such as caries of the vertebræ, deep-sloughing bed-sores in cases of paraplegia, or other instances of inflammatory processes contiguous to the spinal canal. Any of these latter conditions may also set up a leptomeningitis, in association with one of the other forms of meningeal inflammation.

A spinal leptomeningitis may spread so as to implicate the base of the brain; or a cerebral basal leptomeningitis may subsequently implicate the spinal membranes; or, lastly, the inflammation may appear in both regions simultaneously, and thus be from the first cerebro-spinal in seat. The writer has of late seen several cases of the tubercular variety belonging apparently to this latter category; but until the spinal canal has been regularly opened for some time in autopsies of persons dying from this disease, we shall be unable to say what is the exact numerical proportion of such cases as compared with those which are simply cerebral in type. The medulla may be comparatively free from lymph, and yet an inflammation of the spinal meninges may be well-marked. There must, therefore, be a routine opening of the spinal canal for the decision of this question, and not a mere casual inspection of its upper extremity through the foramen magnum.

Anatomical Characters.—According to the stage of the disease at which death takes place, we may meet with the inflammatory process in one or other of three different stages:—(1) that of greatly increased vascularity of the spinal pia mater; (2) one in which, in addition to the increased vascularity, gelatinous serum, lymph, or pus exists in the meshes of the pia mater, and often more marked in amount along the posterior columns. This latter is the condition commonly met with; but in rare cases, where patients have survived an acute attack, we may find (3) certain residuary chronic changes in the form of thickenings, opacities, and undue adhesions of the pia and arachnoid to the spinal cord, which perhaps may itself show a more or less marked condition of peripheral sclerosis.

In the tubercular variety we frequently have to do with a mere gelatinous serum, or thin greenish-yellow lymph (similar to that met with at the base of the brain) rather than with actual pus in the meshes of the pia mater. Careful scrutiny of the vessels in the anterior fissure and in other parts may also show the characteristic 'granulations,' in the form of opalescent, whitish, or yellowish-white specks.

In both forms of the disease the *nerve-roots* are implicated in various ways. They are usually involved in the inflammatory process, and may be much pressed upon by lymph and other hyperplasic products. The nutrition of the cord itself is probably profoundly altered, owing to the existence of an inflammatory process affecting the network of vessels from which its blood-supply is derived; and, moreover, the organic continuity existing between the pia mater and the off-shoots of connective tissue which extend into it on all sides, around the blood-vessels that penetrate its substance, makes it only natural to suppose that the inflammatory process would more or less invade the substance of the cord itself. And this, as the observations of F. Schultze have shown (*Berlin. Klin. Wochenschrift*, 1876, No. 1), actually does occur. But further researches are needed in this direction, in order that we may know the frequency with which grave changes of this kind are produced.

Symptoms.—General listlessness and a sense of chilliness have been noticed as premonitory symptoms in some cases of spinal meningitis. At other times the disease has been observed to commence with a more marked feeling of chilliness, accompanied or quickly followed by some febrile elevation of temperature, together with a full, rapid pulse. Soon there supervenes a deep-seated, boring pain in the back, varying in situation according to the degree of intensity of the inflammatory process at different levels. Pains also extend round the body in girdle fashion, and likewise into the limbs. Whilst the pains in the back are more or less continuous, though greatly aggravated by all attempts at movement, those felt in the limbs and trunk may be only experienced when attempts to move are made. Movement excites the dorsal pain far more than pressure upon the vertebral spines, or light tapping over the same region.

Rigidity of the spine, from muscular spasms, either localised or general, and also rigidity of the limbs, or even of special muscles, may coexist with the pains in the back and limbs. There is often an exaltation of reflex movements in the early stages of the disease, though this condition is nothing like so well marked as it is in tetanus.

At the same time marked hyperæsthesia of the skin exists over considerable regions of the trunk and extremities. The patient cannot bear to be touched, however lightly; and still less can he endure to be moved. He is irritable or plaintive if these proceedings be attempted. Owing to the varying nature and extent of the spasms, and the different amount of pain endured, the position assumed by the patient is very various in different cases.

Difficulty in defæcation and in micturition often exists, especially in the early stages of the disease, and this is supposed to be due to a spasmodic condition of the sphincters. The respiration and the heart's action are principally interfered with in cases where the cervical meninges are gravely involved.

The temperature seems to pursue a somewhat irregular course, but concerning this further information is needed. It may be only slightly above the normal; and may not rise much beyond 102°, even in fatal cases, till near the end. Then it may rise considerably in the course of a few

hours; whilst in other cases it may at this same period become depressed below the normal.

In the later stages of the disease some amount of paresis, or actual paralysis, may be noted in one or more limbs; the pains on movement and the skin-hyperæthesia become less, or may indeed be intermixed with tracts in which actual anæsthesia exists. The bladder may at last be paralysed; and respiration may be most gravely interfered with, so that disturbance of this function, as well as of the heart's action, may be the actual cause of death.

These symptoms are, in all probability, as Erb maintains, due in very great part to the inflammatory and other changes by which the anterior and posterior nerve-roots are implicated. Others may be due to extensions of the inflammatory process to the substance of the spinal cord, thus leaving a somewhat uncertain minority of symptoms to be accounted for by the mere implication of the pia mater itself.

The grouping of symptoms is apt to vary much in different cases, according as there is or is not the coexistence of a cerebral meningitis; or, in the absence of this complication, according as the inflammation is more or less localised in different regions of the cord, or general in its distribution. Much will depend also upon the severity of the process, and upon the extent to which the substance of the spinal cord becomes involved in the course of the disease.

Diagnosis.—Fever; pains in the back and limbs, greatly aggravated by movement; together with stiffness of the neck, trunk, or limbs; local muscular spasms; hyperæsthesia of the skin; retention of fæces and urine; dyspnœa; with a tendency in the later stages to the supervention of paresis, or actual paralysis of limbs—these are the symptoms, the combination of which to a marked extent becomes almost typical of spinal meningitis.

Its complication with a basal cerebral meningitis is, amongst other signs, chiefly indicated by the occurrence of vomiting, headache, slight delirium or stupor, paralysis of ocular muscles, difficulty in deglutition, loss of speech, or convulsions. The presence of many of such symptoms may, from their great importance, tend to dwarf or obscure those due to the inflammation of the spinal meninges alone; on the other hand, if they are absent we may feel assured that the inflammation has not also attacked the base of the brain.

The fact that a meningitis is spinal in seat, and unaccompanied with cerebral symptoms, is of itself exceedingly good evidence to prove that it is not the tubercular form of the affection.

To settle the question, which membranes of the cord are inflamed in any given case, we must be guided much by what we can learn concerning the causal conditions and the distribution of the inflammation, rather than by any at present known differences in the grouping of symptoms. Thus inflammations of idiopathic origin, or those which are cerebro-spinal in seat, will almost invariably be found to be instances of leptomeningitis; whilst those set up as a result of caries of the vertebræ, or as a sequence of a sloughing sacral bed-sore, are certainly much more prone to take the form of pachymeningitis, or of this in combination with arachnitis.

In reference to the diagnosis of spinal meningitis from other affections, it may be said that a very slight amount of attention to the nature of the pains and attendant conditions, will suffice to avoid the mistake of supposing them to be rheumatic in nature. And, similarly, the absence of trismus in the early stages, and of any extremely well-marked exaltation of reflex excitability, together with the presence of severe pains in the back and limbs, will be negative and positive characters sufficient for distinguishing spinal meningitis from tetanus.

Another disease with which spinal meningitis is liable to be confounded, is acute softening of the spinal cord. But the distinction should be easy in the early stages; and the history of the course of the affection will guide us later on, when symptoms of actual paralysis may have become developed. Still, in certain cases, a spinal meningitis may entail a softening of the cord to a marked extent, and then the symptoms of the primary affection will gradually be merged in those of the other which it induces.

A very rare condition, once met with by the present writer, is, he thinks, almost impossible to be diagnosed from spinal meningitis—that is, where a sarcomatous or carcinomatous new growth springs up rapidly throughout the spinal pia mater in the situation usually occupied by lymph or pus, especially when, as in the instance referred to, the disease seems to be the direct sequence of a fall from a height or over a flight of steps, and death takes place within a period of six or eight weeks (see *Lancet*, vol. 1. 1880, p. 988).

Prognosis.—The prognosis of spinal meningitis depends a good deal upon the nature of the primary or causal conditions; upon the question whether the disease shows a tendency to extend to the cerebral meninges; upon the severity with which it implicates the cervical region of the cord; and also to some extent upon the age and general state of health of the person attacked.

It is a disease which proves fatal in the course of a few weeks in a very large percentage of cases; complete recovery is certainly a rare exception; but late and partial recovery—that is, after the disease has lasted long, and with the remainder of some amount of muscular atrophy or incurable paralysis—is a little more frequent. In such cases the disease after a time lapses into a chronic condition, and the patient very gradually recovers, except, perhaps, for such incurable sequelæ as are above mentioned. But even in these cases tending towards recovery, a relapse is most easily brought about, owing to the recommencement of the disease in an acute form.

Where spinal meningitis supervenes upon a sloughing bed-sore existing in a case of paraplegia, the end is usually not far distant. The gravity of any case of spinal meningitis is also always greatly enhanced when the disease spreads to the cerebral meninges. And, so far as the spinal meninges themselves are concerned, any great intensity of the inflammatory process in the cervical region, is always of the gravest import, because of the liability to secondary implication of the cord itself in these regions, either structurally or functionally, and the

bringing about from this cause of serious interference with the functions of respiration and circulation. A continuously rising temperature in such a case—to 105° and onwards—is also of fatal import.

Treatment.—The severity of the disease is apt to prompt to the use of active measures of questionable utility; amongst these may be cited free local blood-letting, the free application of ice to the spine, and active purgation. It is difficult, too, to say on what principle it is thought absolutely necessary to apply cold when we have to do with an inflammation within the spinal canal or within the cranium, whilst we almost always apply heat externally in the case of an inflamed pleura, an inflamed peritoneum, or even to an inflamed skin-tract. Probably the application of ice in such cases tends to alleviate pain, so that where this is great its use may bring much relief to present suffering, when hot applications would only aggravate it. But were it not for the fact that in meningeal inflammation (whether spinal or cerebral) increased fulness of vessels around sensitive organs shut in by unyielding walls, almost necessarily leads to aggravation of pain, the application of heat would probably be more beneficial than that of cold, so far as the possible resolution of the inflammatory condition itself is concerned.

The patient should certainly be kept in a cool, quiet room, and lying either on his side, or, if possible, on his face on a comfortable bed. He should be well supplied with spoon diet of the most nourishing description, together with eggs and a moderate amount of stimulants, according to the indications presented by his symptoms and general condition.

Blisters may be applied along each side of the spine alternately, or the same regions may be painted with liquor iodi. Pain should also be eased by opium or morphia; in fact, an opiate treatment may be resorted to in a large proportion of the cases. When opium and morphia do not agree, or are not admissible, Indian hemp would be worthy of trial as a mere anodyne; or we must fall back upon bromide of potassium and chloral, though the latter must be used with great caution where the heart's action is slow, irregular, and seriously interfered with. Belladonna and ergot have also been recommended, on somewhat doubtful grounds, as anti-inflammatory remedies.

We ought, in fact, to endeavour to combat the most urgent symptoms as much as possible, even if we cannot, by counter-irritants and by the judicious use of drugs, modify the course of the inflammation. Also by suitable feeding and judicious nursing we should endeavour to tide the patient through the disease. And if, happily, the activity of the inflammatory process subsides, the most unremitting attention will still be required to protect the patient against a relapse. Should his condition otherwise admit of it, the absorption of inflammatory products would, in this stage, be likely to be promoted by the use of a small dose of bichloride of mercury (such as one-sixteenth of a grain for an adult), in combination with increasing doses of iodide of potassium. At the same time, every effort must be made to restore the patient's general health, and to combat the emaciation which the disease itself usually involves.

**2. Meninges, Spinal, Hæmorrhage into or upon.**—Synon.: *Hæmatorrachis*; Meningeal Apoplexy (Spinal).

Effusions of blood upon, between or beneath the spinal meninges are altogether rare events, contrasting notably in this respect with the comparative frequency of parallel conditions on the side of the cerebral meninges.

Ætiology.—Among the causes of meningeal hæmorrhages, stabs, blows, or falls will hold a first rank. After these causes we should have to cite impediments to the circulation of blood, occasioned by various respiratory or muscular spasms, occurring either in the course of whooping-cough, or during some more than usually violent convulsive attack, epileptic, tetanic, or other. The lifting of heavy weights, or other great voluntary muscular exertions, may likewise at times prove causes of spinal meningeal hæmorrhage. Occasionally, however, it occurs independently of any such, or of other readily assignable causes.

Anatomical Characters.—Fluid blood or blood-clots may exist in relation with the spinal meninges in three different situations.

The most frequent site of such hæmorrhage is (1) outside the dura mater, between it and the vertebral arches. Here large clots are sometimes found, wholly, or more frequently in part, surrounding the dura mater in the region in which the hæmorrhage has occurred. Where the effusion is large, the cord itself may be distinctly compressed, but even smaller effusions may produce some amount of compression of nerve-roots. A clot in this situation, as in other sites, will, of course, become much modified in appearance with age.

Clots and more or less fluid blood may also, but more rarely, be met with (2) inside the dura mater, within the so-called arachnoid sac. This occurs perhaps most frequently as a mere sequence of a similar hæmorrhage taking place in the cerebral meninges, the blood simply gravitating into the spinal canal. Sometimes, however, especially in cases of spinal pachymeningitis, blood is actually effused in this situation—and that where the internal surface of the dura mater is much more vascular than natural. The opening of a thoracic or abdominal aneurism may also occasionally take place into the spinal canal, and thus produce sudden and grave compression of the spinal cord.

Much smaller extravasations of blood are also met with (3) beneath the arachnoid and within the meshes of the pia mater, over areas perhaps small in extent longitudinally, but more or less embracing the cord in one or more regions. The cord or nerve-roots may, however, be decidedly compressed by such hæmorrhages, even when they are small in amount, owing to the space into which the effusion takes place being comparatively shallow.

Symptoms.—The symptoms of these affections are in a large proportion of the cases vague and ill-defined. They may be much obscured by the causal conditions. In other cases they will vary

in distinctness according to the amount and abruptness of the hæmorrhage.

As a rule, the onset of symptoms is sudden. Pain in the region of the spine, in which the hæmorrhage exists, or radiating thence along the nerves emanating from this region, may be the first symptom. More rarely, muscular twitchings or spasms may exist, either alone or with pains. These symptoms, dependent upon irritation and compression of sensory and motor nerve-roots, are at other times almost wholly absent. There may then be as abiding symptoms mere numbness or tingling in the parts affected, together with a sense of weight and paresis in the limbs. Actual paralysis is rare; and even when it is present, the rectum and bladder mostly escape.

Where pain exists, there is often stiffness of the spine; and these both together greatly interfere with movement. Febrile reaction is usually absent or very slight. The severity of the symptoms may abate after a day or two, leaving only more or less paresis. In the case of large hæmorrhages, however, with extensive compression of the spinal cord, death may be rapid, occurring in the course of some hours or of a day or two.

The symptoms will vary as the effused blood presses upon the cord in the cervical, the dorsal, or the lumbar region. Where the effusion is in the cervical region in a traumatic case, in which there is obvious head-injury with a condition of stupor, it is almost certain not to be diagnosed. The patient is not sensible enough to complain of pain; and the irregular respiration and small disordered pulse, with slight tremor or rigidity of one or both upper extremities, may with more probability be ascribed to multiple head-lesions—as actually happened in a case which recently came under the writer's notice.

Diagnosis.—It may be impossible to diagnose hæmorrhage into the spinal meninges in cases where it occurs as a concomitant of other grave diseases—such as tetanus, eclampsia, or cerebral hæmorrhage; and also in cases where it merely complicates a traumatic injury of the spinal cord itself. In other cases, the presence of certain causal conditions, together with the abrupt commencement of spinal symptoms in such combinations as have been above referred to, is sufficient to enable us to diagnose it from hæmorrhage into the substance of the cord, as well as from meningitis, or acute softening (*see* Spinal Cord, Diseases of). The gradual onset of the symptoms arising from tumours of the spinal cord, or of the spinal meninges, make it more easy to separate these affections from meningeal hæmorrhages.

Prognosis.—Meningeal hæmorrhages are as a class decidedly less grave than meningeal tumours. They are unlike the latter, moreover, inasmuch as the worst symptoms attendant upon them are produced at once, instead of being only very slowly evolved; so that after a short time, unless the blood effused happen to have produced a certain amount of compression of the spinal cord, the symptoms gradually diminish in severity. Large extra-meningeal hæmorrhages, compressing the cervical region of the cord, are by far the most serious forms of this affection.

Treatment.—In the treatment of spinal meningeal hæmorrhage the patient must, of course, be kept perfectly quiet and in the recumbent position. Spoon diet should be administered for a few days; and vascular sedatives, such as aconite, may be given with advantage. Some recommend active purgation, and the abstraction of blood from the neighbourhood of the spinal column by cupping or leeches. These measures, however, are of questionable utility, and the former especially might easily do positive harm.

**3. Meninges, Spinal, New Growths and Adventitious Products of.**—This subject requires no very lengthy discussion. As was said in regard to such growths and products springing from or connected with the cerebral meninges, the symptoms to which they give rise are in the main referable to irritation and pressure upon adjacent portions of the nerve-centres or upon certain nerve-roots. The symptoms, therefore, of meningeal growths or adventitious products are almost, if not quite, indistinguishable from those produced by similar bodies in the spinal cord.

The sections on special symptoms and diagnosis which might otherwise have appeared here may be suppressed; and the reader be referred for their equivalents to what he will find under the head of Spinal Cord, Tumours of.

We shall now merely give a few details concerning the ætiology, nature, and precise sites of the various new growths and adventitious products that may be met with in connection with the spinal meninges, and shall supplement these details with some few general remarks bearing upon the prognosis and treatment of such affections.

Ætiology.—In accounting for certain tumours, such as those of a syphilitic, of a scrofulous, or of a cancerous type, we may fall back upon the existence of a general 'predisposition'; though what determines the appearance of such tumours in this or that particular situation generally remains as much a matter of uncertainty as when the growths are solitary or of non-diathetic origin. Amongst such determining or exciting causes only one of those usually cited seems to be of real potency, namely, the occurrence of blows or injuries of various kinds. These certainly appear at times to be—in the spinal meninges as in other situations — the immediately exciting causes of certain new growths.

Parasites, such as cysticerci and hydatids, gain entry to the system in the way mentioned in the articles on these subjects; but something so indefinite or accidental as to be spoken of by us as 'chance,' will determine their appearance in this or that particular tissue or organ.

A. New Growths.—(*a*) *Cancer.*—Cancer occurs most frequently in the spinal meninges, not as a primary affection, but by extending to them from a previous cancerous growth in one of the adjacent vertebræ. The space within the spinal canal being very limited, such a tumour soon begins to press injuriously upon nerve-roots and upon the cord itself. In rare cases, however, a cancerous new growth may start from the spinal dura mater.

(*b*) *Scrofulous growths.*—These masses are met

with principally in cases of scrofulous disease of the spinal column, and especially where angular curvature is produced, though they are not confined to these more severe forms of vertebral caries. Caseating growths are in such cases apt to extend from the vertebræ, so as to infiltrate the dura mater, and then produce fungating excrescences on its inner surface. Small isolated scrofulous tumours, the so-called 'tubercular' growths, may also be met with, though more rarely than in the cerebrum, springing from the spinal pia mater, and more or less imbedding themselves in the substance of the spinal cord.

(*c*) *Syphilomata.*—Syphilitic growths are also decidedly less frequent in connection with the spinal than with the cerebral meninges. Small tumours may, however, spring either from the dura mater or from the arachnoid and pia mater. Or, instead of well-defined tumours, there may be thickenings of the membranes in some part of their extent, and adhesions between one another and the surface of the cord, by means of opaque, yellowish-white, gummatous growths.

(*d*) *Sarcomata.*—Sarcomatous tumours of all kinds may be met with in connection with the spinal meninges, springing occasionally from the dura mater, but more commonly from the arachnoid and pia mater. Instead of being distinctly circumscribed, such growths may exist in the form of diffuse infiltrations, invading the pia mater all round the cord for a variable extent. In one remarkable case the writer met with a growth of this kind involving the pia mater throughout the whole length of the spinal cord, which was most developed on its lateral and posterior aspects. Here in some places the layer of new growth was about one-third of an inch in depth, and the cord was notably compressed in its postero-lateral aspects (*Lancet*, June 26, 1880, p. 988).

(*e*) *Myxomata.*—Myxomata are met with in the form of small circumscribed tumours, springing mostly from the pia mater. The writer has seen one about the size of a very large almond situated on, and greatly compressing, the posterior columns of the cord. Its presence was associated with very obscure and ill-defined symptoms during life.

(*f*) *Tubercle.*—Tubercles in the form of 'grey granulations' have already been referred to in the description of Spinal Leptomeningitis.

(*g*) *Fibromata*, (*h*) *Lipomata*, and (*i*) *Enchondromata.*—These various kinds of new-growth have been met with occasionally, but principally in connection with the outer aspect of the dura mater.

(*k*) *Osteomata.*—These formations are here of no clinical significance, though they are much more common in persons of all ages on the spinal than on the cerebral meninges. They are apt to occur in the form of small bony plates scattered over the surface of the arachnoid. Sometimes a limited 'ossification' of the dura mater is also met with.

B. **Adventitious Products.**—*Parasites* The same two kinds of parasites may be found in connection with the spinal meninges as we have already had to refer to in connection with those of the cerebrum—namely, the small and often numerous *cysticerci*, as well as the more solitary and larger *hydatids*. The latter may be found within the dura mater, but they have been met with much more frequently outside this membrane, often forming large tumours contiguous to the spinal canal. These are the only adventitious products of any importance which occur in, or in relation with, the spinal meninges.

Prognosis.—As a class these affections are grave, tending to produce, with some exceptions, various irregular forms of paralysis, and ultimately death, though this latter may take place only after the expiration of two, three, or more years. The symptoms produced by tumours and parasites, as a rule, go on increasing in severity; and the gravity of the prognosis will depend much upon their rapidity of growth, as evidenced by the increase of signs of severe compression of the cord or of its nerve-roots, in connexion with the state of other organs. The supervention of obstinate bed-sores, and paralysis with inflammation of the bladder, may at last greatly hasten the fatal termination.

Treatment.—In the treatment of tumours or parasites within the spinal canal, our efforts must be in the main directed to restoring or improving the general health of the patient, and to combating the more urgent symptoms that may arise—such as pain, spasms, paralysis, sleeplessness, bed-sores, and cystitis. Where, however, we have to deal with growths of syphilitic origin, we can attack the disease itself by means of drugs. Under the influence of small doses of mercury and increasing doses of iodide of potassium, the patient's condition may often be marvellously improved, though the relief is perhaps not so striking as in cases where syphilis affects the cerebral meninges, because in this latter disease the symptoms are more varied in nature, and more dependent upon added functional complications.

H. Charlton Bastian.

**MENINGOCELE.**—*See* Brain, Malformations of; and Skull, Diseases of.

**MENINGO-CEREBRITIS.** — A name given to a pathological condition in which inflammation of the pia mater extends in some regions of the cerebrum so as to implicate the subjacent cortical substance. The fact of such an extension is much less capable of being diagnosed during life than of being discovered after death, but it may then be recognised by the existence of superficial softening of the brain-substance, together with a more or less marked increase of vascularity. This condition probably always exists to a certain extent in meningitis, and might reveal itself on careful microscopical examination—although the inflammatory changes may not have advanced far enough to produce an easily appreciable amount of softening.

**MENINGO-MYELITIS** is a term used to indicate a condition in which inflammation of the spinal meninges has extended to the surface of the spinal cord. The evidence of such an extension has usually been supposed to depend upon the existence of an appreciable amount of superficial softening. But minor changes of an inflammatory type, capable of recognition by the

microscope, may also here exist with frequency, as F. Schultze has shown, although they may fall short of entailing actual softening.

**MENOPAUSE** (*μηνὲς*, the menses, and *παῦσις*, a cessation).—The natural cessation of the menstrual flow, or 'change of life' in the female. *See* CHANGE OF LIFE.

**MENORRHAGIA** (*μὴν*, a month, and *ῥήγνυμι*, I burst forth).—Over-abundant menstruation, whether due to excessive quantity, or to undue frequency. *See* MENSES or MENSTRUATION, Disorders of.

**MENSES or MENSTRUATION, Disorders of.**—SYNON.: Fr. *Troubles de la Menstruation*; Ger. *Störungen des Monatsflusses*; *Störungen der Menstruation.*

Menstruation is the periodic discharge of a sanguineous fluid from the female generative organs. The discharge continues each time for from three to eight days. It varies in quantity in different subjects. The estimation of this is surrounded by great difficulties; usually, however, the quantity is from four to six or eight ounces. It takes place monthly; that is, a period of twenty-eight days intervenes from the appearance of one flow to the appearance of the next following. In many cases, however, this interval is less than twenty-eight, and may be as short as twenty-one days; on the other hand, it may be prolonged to thirty-one days, and the function be still performed normally. The discharge does not appear during childhood or old age. It usually appears for the first time between the twelfth and fifteenth years, and for the last time between the forty-third and forty-eighth; but it may appear as early as the ninth, and continue to appear regularly afterwards up to the fifty-third or fifty-fifth year. The function is suspended during pregnancy, and, as a rule, during lactation. The source of the discharge is the body of the uterus. It is not due to a congestion or an erection of that organ, as has been supposed, but to the degeneration, disintegration, and removal of the so-called mucous membrane of the uterus—the decidua menstrualis. In consequence of this degeneration and disintegration, the vessels on the inner surface of the uterus are opened, and hæmorrhage follows. The ultimate cause of the discharge is said to be the separation of ova; such, however, is not the case in every instance, for menstruation may take place without the discharge of an ovum, and, on the other hand, ova may be separated from the ovary without the occurrence of menstruation. It can hardly be doubted, however, that the function is in some manner dependent on the ovaries, for when the latter have been removed menstruation ceases.

The fluid is not in all cases sanguineous; indeed its bloody character may be regarded as accidental, though present in the infinite majority of cases. It may, however, be easily understood that the disintegration and removal of the 'decidua menstrualis,' which is the essential factor in menstruation, may be effected without the occurrence of hæmorrhage, and there is reason to believe that in so-called 'white menstruation' such is the case.

For the due performance of the function two conditions are essential, namely, sound general health, and normally developed organs of generation. Disorders of the menstrual process may be brought about by very many conditions. These disorders are generally divided into:—

I. **Amenorrhœa**, where the discharge is absent, or deficient in quantity.

II. **Dysmenorrhœa**, where the function is performed with difficulty and pain.

III. **Menorrhagia**, where the discharge is profuse.

I. **Amenorrhœa.**—SYNON.: Fr. *Aménorrhée*; Ger. *Amenorrhoë.*

ÆTIOLOGY AND SYMPTOMS.—Amenorrhœa is dependent either on *general* states; or on *local* pathological conditions—that is, on lesions of the uterus and ovaries.

1. All conditions or influences which tend to deteriorate the blood, or which act unfavourably on nutrition, may be causes of amenorrhœa. The most common of these is the demand made on the system in the development of the aptitude for conception, the growth and separation of ova, and the performance of the menstrual function. At this time the breasts develop, the ovaries and uterus enlarge, the pelvis grows, and the whole form becomes altered. Many women who during childhood have enjoyed apparently perfect health, as they approach puberty become gradually or suddenly anæmic or chlorotic, without any assignable cause other than the demand made on nutrition by the process of development through which they at the time pass. Nutrition becomes impaired, tastes perverted, pains of a neuralgic character are felt in various parts of the body, the menstrual discharge does not appear, or it may appear once scantily, and then at irregular intervals, or it may disappear for months or even years. All the symptoms of anæmia are present, and the patient is languid, listless, lacks energy, and is in more or less constant suffering. The above may take place in cases where the surroundings may be favourable to healthy development. Hygienic conditions, however, play a most important part in the proper development of the female functions, and when the surroundings are unfavourable, evil is sure to follow. Want of food, or improper food, want of fresh air, impure air, want of exercise, foul gases, malaria, are prolific causes of failure or imperfection in the growth and development of the young girl, and are common causes of amenorrhœa. Disease also is a by no means infrequent cause of the condition under consideration, as phthisis, Bright's disease, diseases of the liver, stomach, and nervous system. Emotion, fright, or grief, change of air and food (as when girls go from the country to London), and cold, may arrest or suspend the monthly discharge.

2. But amenorrhœa may be due to local conditions. These are absence or disease of the ovaries, of the uterus, or of both; and imperfect development of one or both organs.

In cases where the ovaries are absent, the change in form, from girl to woman, which takes place at puberty, does not occur. The girl

grows but does not develop. A masculine appearance supervenes, the breasts remain small, the pelvis narrow, the voice becomes manly and harsh, a beard may grow on the face, sexual passion is absent, and the health remains good.

When the uterus alone is wanting, there may be no indication of the condition in the state of the general health or development, and local examination is necessary in order to detect the circumstance. In these cases the vagina terminates in a *cul de sac*, and the uterus cannot be felt on examination. On introducing a finger into the rectum and a sound into the bladder, it is found that the two organs are in contact, and that there is no uterus between them. There are, however, as a rule, one or two small fibrous masses representing the uterus.

Certain diseases, as scrofulous abscess and atrophy, which involve the whole substance of the ovaries, and also atrophy of the womb, may cause amenorrhœa.

*Amenorrhœa from retention.*—In these cases the sanguineous discharge is separated, but does not appear externally, owing to atresia of the genital canal. The closure may occur at any point between the os uteri and the vaginal orifice. A membrane may close the os tincæ; the hymen may be imperforate; the vagina may be absent, or its walls may be adherent at any part of its course, or along the whole of it. The occlusion may be congenital, or may arise from inflammation during childhood, or after severe labours. In these cases the menstrual molimina are periodically present, but the catamenia do not appear. The molimina increase in severity from month to month; the patient has pain in the back, a sense of weight in the pelvis, and becomes pale and sallow; the abdomen after a time begins to enlarge, and continues to increase. On examination a tumour having the shape of the enlarged uterus may be felt rising from the pelvis. It is smooth, elastic, and dull on percussion. If the condition be not discovered, the distension of the uterus may go on to rupture, or its contents may pass along the Fallopian tubes into the abdomen, causing peritonitis and death.

Diagnosis.—Whenever a patient suffers from amenorrhœa, pregnancy must be thought of. If this state can be excluded, the general condition must be investigated. Anæmia and its causes should be sought for. The chest, heart, and urine must be examined. If there be no general condition to account for the amenorrhœa, the practitioner must see whether the breasts and pelvis are developed, and examine the vulva and vagina for obstruction, if there be any suspicion of such a condition. Finally it may be necessary to examine the uterus and ovaries.

Treatment.—The treatment of the first form of amenorrhœa is the treatment of the general state. If there be want of constitutional vigour, change of air, exercise in the open air, mental occupation, but not severe, and nourishing diet should be advised. The stomach and bowels must be attended to; and gentle aperients and salines given if the tongue be foul; then vegetable tonics, iron, iodine, or other appropriate remedies. No efforts should be made to act especially upon the uterus, and this is particularly binding when the amenorrhœa is dependent on phthisis, Bright's disease, or such-like conditions.

The second form is often incurable. In those cases where the uterus and ovaries are absent nothing can be done. If the uterus be present, but imperfectly developed, means should be used to promote its growth. With this view stem pessaries, galvanic pessaries, and irritants have been advised. Galvanism will probably prove a useful agent in these cases. It should be tried first externally, one pole being applied to the spine and one over the uterus and ovaries. Should this fail, one pole should be applied to the uterus direct, and the other above the pubes, and to the ovarian regions. These means, which are not free from danger, should, however, never be tried where the amenorrhœa is not associated with suffering of some kind. Indeed, amenorrhœa in many instances requires no treatment at all.

In cases of retention from atresia of the genital canal, an outlet must be made for the flow. If the hymen be imperforate it should be divided, and the fluid allowed to run out. In cases of absence of the vagina, a canal has in some instances been successfully made. In atresia of the os uteri the offending structure should be divided by the trochar or knife. These operations are accompanied by a considerable amount of danger. Patients not infrequently die after them from peritonitis or shock. It should not be forgotten, however, that it is imperative to remove the menstrual fluid retained, for unless this be accomplished death is inevitable.

II. **Dysmenorrhœa.**—Synon.: Fr. *Dysménorrhée*; Ger. *Dysmenorrhoë.*

In dysmenorrhœa, menstruation is accompanied by pain. In some women the menstrual function is performed without pain or discomfort of any kind; as a rule, however, they suffer more or less from backache, headache, languor, and lassitude during the catamenial flow. When the dull aching amounts to sharp pain, the function is performed abnormally, and the woman is said to suffer from dysmenorrhœa.

Ætiology and Symptoms.—This symptom has been referred to five different conditions, upon one or more of which it is supposed to depend, and hence there are five kinds of dysmenorrhœa recognised, namely:—

1. *Mechanical* or *obstructive.*
2. *Congestive* or *inflammatory.*
3. *Neuralgic, sympathetic,* or *spasmodic.*
4. *Membranous.*
5. *Ovarian.*

1. *Mechanical dysmenorrhœa.*—Mechanical dysmenorrhœa is doubtless the most common of the above forms. Indeed, it has been said that dysmenorrhœa cannot exist without obstruction to the flow of blood from the uterus. Opinions, however, differ greatly with regard to the seat of obstruction. It may exist in the vagina or in the uterus. Dr. Robert Barnes believes it to be usually situated at the os tincæ, and to be frequently accompanied by conical cervix. Dr. Marion Sims thinks its most frequent seat is the os internum uteri. Dr. Graily Hewitt refers the obstruction to flexion of the uterus in the great majority of cases. That the outer orifice of the uterus is occasionally so small as to cause ob-

struction to the catamenial flow has been proved beyond question, but there is no evidence of the great frequency of this condition. Still less evidence is found of the existence of obstruction at the inner orifice. Flexions of the uterus need be acute to present obstruction to the flow; in such cases, at the point of flexion the canal of the uterus is flattened, and its walls are not easily separated. Retroflexion is a more frequent cause of dysmenorrhœa than antiflexion, because, as a rule, the angle of flexion is more acute in the former than in the latter. It should, however, be borne in mind that a very fine channel, even a pinhole os, may suffice to permit a fatal hæmorrhage, and it is probable that a very narrow canal would prove capable of the painless passage through it of the menstrual discharge when the latter is in a healthy state—that is, when it contains neither clots of blood nor fragments of membrane. There are reasons for believing that in the great majority of cases of painful menstruation, the cause of the obstruction does not lie in the genital passage, but in the menstrual fluid itself, because the latter, instead of being a homogeneous mixture of blood, mucus, and the molecularly disintegrated decidua, contains small fragments of the inner surface of the uterus, clots, and masses of viscid mucus; and that while the orifices of the uterus would easily permit the passage of healthy menses, they do not suffice for the painless expulsion of such particles as have been enumerated.

This form of dysmenorrhœa is very common. It is frequently accompanied by inflammation or congestion of the body of the uterus, as well as by inflammation and abrasion of the lining membrane of the cervix. That these complications contribute to enhance the pain caused by the obstruction present during menstruation cannot be doubted. At the same time it should be borne in mind that the complications are probably secondary. Indeed, primary inflammation of the unimpregnated uterus is of infinite rarity; it depends on the obstruction which had been at work for years before the inflammation set in.

The symptom of this variety is pain of varying intensity; in some cases it is of a very severe character. It begins in the pelvis, and radiates to the groin, sacrum, and thighs. It is often said to be all round the pelvis or lower part of the trunk. It may come on a little before, with, or a little after the appearance of the discharge, and may cease with or soon after the same; or it may continue more or less severe, but always paroxysmal, until the end of the flow. There is often tenderness of the skin of the hypogastrium and groins; vomiting, hiccough, headache, hysteria, and even delirium may be present. The flow may be scanty or profuse, and in the former case it is often followed by an abundant yellow discharge for a few days. There may be leucorrhœa throughout the inter-menstrual interval. Micturition is often painful.

2. *Congestive or inflammatory.*—This name has been given to those cases of painful menstruation in which the uterus is enlarged, and heavier than natural. It is met with in the married and in the single; but it is probable that it never occurs as a primary affection, but is the result of obstruction, abortion, or labour. The symptoms are those of mechanical dysmenorrhœa. The state of enlargement can be diagnosed by digital examination only.

3. *Neuralgic.*—This variety at one time included a very large number of the cases of painful menstruation which came under notice; but since more efficient means have been employed for learning the condition of the uterus, the number of cases referred to this category has greatly diminished. At present it is limited to the cases of young girls, in whom it is not desirable to make a vaginal examination; and to those cases in which no pelvic lesion can be found to account for the suffering. It cannot be said that neuralgia of the uterus never exists; at the same time it is of such rarity that it should be diagnosed with the greatest hesitation.

The symptoms are similar to those of the obstructive variety.

4. *Membranous.*—In this form a membranous sac, having the shape of the cavity of the body of the uterus, is expelled with the catamenia. The sac has three orifices, corresponding to the orifices of the Fallopian tubes, and the inner orifice of the neck of the uterus. It has an internal smooth, punctated, and an external flocculent surface. Occasionally during expulsion the sac is turned inside out. It may be passed with every, or with every other, menstruation, or only occasionally. Instead of being passed in the form of a complete sac, the membrane may be broken up, and expelled as shreds of various sizes. Microscopic examination shows that the membrane possesses a structure identical with the lining of the body of the uterus. It contains glands and blood-vessels, and is, in fact, the decidua. It has been said that it is always the result of conception, but ample evidence has been published to refute this statement. As a rule the uterus is enlarged; this, however, is not always the case. The enlargement is probably a condition secondary to the dysmenorrhæa, or to previous gestation. There is commonly tenderness of the pelvic tissues around the uterus, probably of the peritoneum; ovaritis is frequently present. All these conditions are probably secondary.

Displacement of the uterus is also not an uncommon complication—an anteflexion or retroflexion: an affection of another mucous membrane may also co-exist.

The symptoms are usually very severe, the pain being most intense, of a bearing-down character, and often compared to labour-pains. It reaches its acme just before the membrane is expelled. If the membrane be passed in fragments, the pain recurs with the passage of each. The pain accompanying the expulsion may be slight, or even absent. In the latter case the uterus is large, and the os patulous. The passage of the membrane takes place often on the third day of menstruation, but may occur later; frequently shreds are passed from the first or second day at intervals to the end of the flow. With the expulsion of the membrane, there is generally a gush of blood, after which the flow proceeds normally. The catamenial discharge may be normal in amount, considerably increased, or even scanty.

The pathology of this affection is unknown. It has been said to be the result of conception. Cases of abortion may probably have been mistaken for this affection, but that it occurs independently of sexual connection is amply proved. It has also been said that it is due to inflammation; that the membrane expelled is an inflammatory exudation. The evidence in favour of this view is very scanty. Inflammation or congestion of the uterus is frequently met with in cases of membranous dysmenorrhœa, but not always. Indeed, cases of this affection occur in which no trace of inflammation of the uterus could be found either before or after death. More recently it has been stated that it is due to amyloid degeneration of the lining membrane of the uterus. If this be the fact in some cases, it certainly is not in all. It is more probably due to malnutrition, which in some cases has existed *ab initio*. It has been met with also in gouty and rheumatic subjects, but what relation it holds to these diatheses is unknown.

5. *Ovarian.*—This does not deserve the name of dysmenorrhœa, for it is not due to menstruation—that is, to the discharge of the sanguineous fluid from the uterus—but to the growth and rupture of the Graafian follicles. The Graafian follicles develop gradually, and take a long time to arrive at maturity. It is not a sudden process. It is, however, towards the end of their growth, as they approach the time of rupture, that they become painful. They usually burst some time before the appearance of the menstrual flow, but this may happen during the catamenia, or after their cessation. The pain usually comes on before the catamenia, a few days or a week, and may cease with the appearance of the menses, or several days before that event. The suffering may, however, come on at any time during the flow or during the interval. It is situated usually in the left ovarian region, for the left ovary is more frequently affected than the right. The pain extends down the thighs, and to the sacro-iliac joint of the same side. Not infrequently the corresponding kidney is tender. Pain may occur in the left and right side at alternate periods, or a period may pass without pain. Vomiting and hysteria are often present. There is superficial and deep tenderness over the painful part. Patients often say that they have a swelling in the side, and on examination a diffused fulness is found in the ovarian region, which is tympanitic, and due evidently to local distension of the intestine by gas. Examination *per vaginam* and *per rectum* will often detect a small tumour, tender, movable in the early periods, later on fixed, on the side affected, and a little behind the uterus. Pressure on the tumour calls forth severe pain and a feeling of sickness. Later on the uterus becomes less movable, and drawn to the affected side. This is doubtless due to contraction of inflammatory products, and not to distension of the broad ligaments, for it occurs in long standing cases only. Micturition is frequent and painful.

The pathological lesion is inflammation of the Graafian follicles, of the stroma, or surfaces of the ovary, extending to the neighbouring tissues. This, again, is rarely primary. In women who have had children, it is often due to parturition and abortion. In the unmarried it is the result of long-standing dysmenorrhœa. In the latter cases true dysmenorrhœa is always primary, and ovaritis secondary. It may, however, be the result of exposure to cold during menstruation.

Many diseases of the uterus, as fibroid tumours, polypi, cancer, &c., cause dysmenorrhœa.

Treatment.—Dysmenorrhœa is often very obstinate under treatment, and its course is very protracted. In many cases much may be done by attention to the general health, and to the stomach, liver, and bowels.

During an attack rest in bed should be enjoined, and hot baths, anodynes—opium, morphia, chloral, or chloroform—be administered for the relief of the pain. Saline aperients, iron, arsenic, and bismuth, are of service during the intervals. If there be a gouty or rheumatic tendency, this must be treated. But recourse must be had in the great majority of cases to local treatment, and the plan adopted will depend much on the view taken, not of the individual case, but of dysmenorrhœa generally. Should displacement be found, it should be corrected. Frequently, however, when this has been accomplished, the suffering continues. Clots are commonly found in the discharge, and the cervical canal is not capacious enough to permit their passage. In these cases the channel must be enlarged. This may be done in several ways:—

1. By graduated bougies, similar to those in use for dilating stricture of the urethra. One or more of them are passed at intervals of several days, until the necessary dilatation has been accomplished.

2. A dilator, such as Priestley's or Ellinger's, may be introduced into the uterus, and the orifices forcibly and suddenly dilated.

3. Tents of compressed sponge, or of *laminaria digitata*, may be passed into the canal, and allowed to remain there for six or ten hours, until it has been well dilated.

These means, however, are unsatisfactory, for the orifices regain their original state—the dilatation is not permanent. To obviate this contraction, recourse has been had to incision of the supposed contracted part. The best method is that first proposed by Dr. Marion Sims, that is, the division of the external orifice by scissors, and of the internal, if necessary, by means of a blunt pointed knife. The operation is performed as follows:—

The patient is placed on a table on the left side, with the knees drawn up. Sims's duck-bill speculum is introduced, so as to bring the cervix uteri to view. It is then given to an assistant to maintain it in position. The cervix is fixed by a sharp hook, and the lips of the uterus divided laterally by scissors. Sims's knife is then introduced through the inner orifice, and as it is withdrawn is made to incise the *os internum* as well as the angle of the wound made by the scissors near the same orifice; the knife is again introduced, and the opposite side incised in a similar manner. Marion Sims recommends incision of the inner and outer orifices; Dr. Robert Barnes the outer orifice only. When the cutting is completed, a strip of lint.

moistened in a solution of perchloride of iron in glycerine, should be introduced into the wound, and a plug of lint into the vagina, and the patient put to bed. The hæmorrhage accompanying the operation is usually slight; sometimes, however, it is profuse, but it can generally be controlled by pressure made against the cervix fixed by a sharp hook, by means of sponge probangs. Rest in bed for one week should be enjoined. The vaginal plug should be renewed every day until the third or fourth day, when the intra-cervical dressing may be removed. The sound should then be introduced daily, to prevent union of the edges of the wound, or an intra-uterine stem may be worn with a similar object. Instruments called hysterotomes have been invented for incising the orifices of the uterus. They are single or double-bladed. The blade or blades are concealed in a sheath during their introduction into the uterus; when this has been done, the blade or blades are made to spring out and incise the cervix as the instrument is withdrawn. The operation is better performed by knife or scissors.

III. **Menorrhagia, and Metrorrhagia.**—Synon.: Vulg. Flooding; Fr. *Ménorrhagie*; *Métrorrhagie*; Ger. *Mutterblutfluss.*

The former term is used to denote profuse menstruation; the latter, hæmorrhage from the uterus at any other time than the catamenial epoch. The two symptoms are frequently met with. Menorrhagia often exists alone. When metrorrhagia is present during menstrual life, the catamenia are, as a rule, also profuse. These hæmorrhages may be called forth by many lesions. Indeed, they may accompany the majority of the pathological conditions to which the pelvic organs are liable. They may also arise from general states—as scurvy, the hæmorrhagic diathesis, Bright's disease, phthisis, cirrhosis of the liver, and the acute specific diseases. The most common cases are, however, met with in the form of distinct alterations of structure in the pelvic organs, as sub-involution of the uterus, polypus, fibroid tumour, cancer, displacements, retained portions of placenta, moles—fleshy or vesicular, fungous degeneration of the mucous membrane of the uterus, mucous polypi, ulcerations of the cervix, hæmatocele, inversion of the uterus, and congestion of the uterus, due to obstruction to the circulation through the heart and lungs or liver.

Profuse hæmorrhages of an irregular character occur also in young girls before the advent of regular menstruation. This form of uterine hæmorrhage is not common, but it is sometimes of very serious import, for occasionally it has proved fatal. More frequent is the occurrence of irregular bleeding from the uterus during the menopause. The causes of these climacteric hæmorrhages are really not known. They have been said to be due to congestion, but on insufficient evidence.

Treatment.—The treatment of hæmorrhage from the uterus resolves itself into the immediate treatment of the attack, and the treatment of the condition leading to it. The treatment of the attack, or the means of arresting the bleeding, consists in great part in securing absolute rest. The patient should remain in bed in the recumbent position, and avoid all exertion—mental and physical. At the same time, internal remedies which tend to check hæmorrhage should be given. Of these, those most commonly used are ergot of rye, gallic acid, the mineral acids, and acetate of lead. Mineral acids, in combination with sulphate of magnesia or soda, often act well. Should acetate of lead be administered, the patient should be carefully watched, as some persons are very sensitive to the action of the drug, and manifest symptoms of acute lead-poisoning after the administration of a small quantity of it. Should these means fail, recourse should be had to plugging the vagina or uterus. The vagina is plugged in the following manner:—The patient is placed on her left side and a speculum is introduced, and the canal is firmly packed with pledgets of cotton-wool or strips of lint, tied on a string for convenience of removal. This will arrest the hæmorrhage for a time, but it can only prove a temporary expedient. The plug is liable to become extremely offensive, from decomposition of blood and of the secretions in the vagina, and should consequently be changed every eight or twelve hours. A more efficient means of arresting hæmorrhage is plugging the uterus itself. This is done by means of tents of sponge or laminaria, and with a twofold object. The first object is the immediate arrest of the bleeding; but the chief object usually is to dilate the canal of the uterus so as to permit its exploration by the finger, and the discovery of the cause of the bleeding. This means will not only check the bleeding temporarily, but will in many cases effect a permanent cure. To facilitate the introduction of a tent a Sims's speculum should be used, and the cervix of the uterus should be fixed by a sharp hook. In many cases, however, tents will not be necessary. The hæmorrhage will be controlled by the other means enumerated, or the cause of the hæmorrhage will be made out without the use of tents. In all cases, however, in which the hæmorrhage is uncontrollable, or so profuse as to threaten life, or in which the cause of the bleeding is obscure, tents should be had recourse to, both to check the flow and complete the diagnosis. When the cause has been discovered, it should, if possible, be removed.

But even after the uterine canal has been dilated no definite cause may be found for the bleeding. In these cases, styptics, or even caustics, may be applied to the inner surface of the organ. Those chiefly used are nitric acid, chromic acid, carbolic acid, a solution of iodine, or a solution of perchloride of iron. These are best applied through a uterine speculum of platinum or vulcanite, on a probe of similar material. While using these means it should be borne in mind that internal uterine medication is not free from grave danger.

The remainder of the treatment of menorrhagia consists in attention to the general state.

**MENSURATION** (*mensura*, a measure).—A synonym for measurement. *See* Measurement; and Physical Examination.

**MENTAGRA** (*mentum*, the chin, and ἄγρα, an attack).—A name for affections of the chin, more general than *sycosis*, and therefore sometimes convenient. *See* Skin, Diseases of; and Sycosis.

**MENTAGROPHYTON** (*mentagra*, and φυτόν, a plant).—The fungus-plant of mentagra, in reality a trichophyton, discovered by Gruby in the hair-follicles and hair in sycosis. *See* Epiphytic Skin-Diseases; Sycosis; and Tinea.

**MENTAL DISORDERS.** *See* Insanity.

**MENTIGO.** *See* Mentagra.

**MENTONE, on extreme east of French Riviera.**—Moderately warm, bracing, sheltered, and dry winter climate. Mean temperature in winter, 48° Fahr. Winds: E. SE., and NW. Soil, sandstone. *See* Climate, Treatment of Disease by.

**MERCURY, Diseases arising from.**—Synon.: Fr. *Hydrargyrie*; *Intoxication mercurielle*; Ger. *Quecksilbervergiftung*.

Though considerable discrepancies of opinion have existed as to the poisonous or innocent properties of the metal mercury itself when swallowed, there can be no doubt as to the poisonous character of its soluble and volatile compounds, nor even as to the insidious nature of the vapours of metallic mercury. Metallic mercury has occasionally been administered in enormous quantities without producing any decided physiological effects; whilst in other instances, salivation and other specific effects have resulted. These differences are doubtless due to the fact, that in those cases where effects have resulted from the administration, oxidation and solution of a portion of the metal had taken place.

Mercurial poisoning may be either (A) **acute**, or (B) **chronic**; the former resulting from the administration of one or several large doses at short intervals, the latter form of mercurialism arising from the repeated exhibition of small doses of the less active preparations of the metal. There is also a peculiar form of mercurialism, which is the effect of the inhalation of the vapours, either of the metal or of its volatile compounds, and is characterised by paralysis.

A. **Acute mercurial poisoning.**—Description.—The effects produced by a considerable dose, say a drachm, of one of the more soluble compounds of mercury, such as corrosive sublimate, or the nitrate, are those of a corrosive and irritant poison. The effects are immediate. In the act of swallowing an intense burning sensation is experienced in the mouth and throat, followed by excruciating pain in the stomach, and extending to the abdomen. The local effects of the poison are frequently visible, as a whitening of the tongue and fauces. There is vomiting, tenesmus, and purging, often of a bloody character. Colic and great tenderness and swelling of the abdomen, are also symptomatic. Not unfrequently there is suppression of the urine. The gustatory sensation is perverted; there is dryness of the mouth; and a brassy or metallic taste is generally experienced after the first local corrosive action of the poison has somewhat abated. The countenance is anxious; the skin is pale, cold, and clammy; and the pulse is small, weak, and rapid. Salivation may supervene, accompanied by fœtor of the breath. Should recovery not take place, death may occur within a few hours, or may be delayed for one or more days; or the patient may more rarely succumb to some of the ordinary sequelæ of corrosive poisoning. When death supervenes speedily after the administration of the poison, the fatal result is usually due to collapse.

Most of the effects of acute mercurial poisoning may result from the application of a concentrated solution of corrosive sublimate to the unbroken skin.

Anatomical Characters.—The *post-mortem* appearances seen after acute mercurial poisoning are inflammation, and even erosion of the mucous membrane of the stomach, and extravasation of blood beneath this membrane. Ulceration is rare. The intestinal tract also exhibits signs of extensive inflammation, and this has been noticed especially in the large intestine. The rectum is usually much inflamed, and its surface covered with shreds of bloody mucus. A peculiar slaty appearance of the mucous membrane of the stomach and intestines, where not highly inflamed, has been thought to be characteristic of corrosive sublimate poisoning.

Diagnosis.—Though the symptoms of poisoning by corrosive sublimate, and other corrosive preparations of mercury, greatly resemble those produced by arsenic, the diagnosis is generally not difficult. The effects following almost immediately on administration, the metallic taste in the mouth, and the greater frequency of bloody stools in mercurial poisoning, serve to differentiate between the poisons. Where doubt exists, an analysis of the secretions may be made; arsenic is most readily detected in the urine, and mercury in the saliva. The existence of salivation and fœtor of the breath—though not always present—may also be valuable aids in completing the diagnosis.

Treatment.—In acute poisoning by corrosive sublimate, the best antidote is albumen, or the albuminoids in any soluble form. The white of one or more eggs should be beaten up with water, and swallowed as quickly as possible. Failing an egg, flour made into a thin paste may be administered. Albumen combines directly with corrosive sublimate to form an insoluble compound. On account of the powerful local action of the poison on the stomach, the use of the stomach-pump is not advisable; but if the vomiting be not free, emetics of as simple character as possible may be administered. The rest of the treatment consists in alleviating pain by means of opiates, and the general treatment applicable for irritant poisons. Thirst must be alleviated by demulcent drinks. For this purpose milk, mixed with once or twice its bulk of lime-water, is excellent; the casein of the milk and the lime both tending to render the mercury insoluble, and so to act as antidotes.

B. **Chronic mercurial poisoning.** Synon.: Mercurialism.

Description.—The repeated ingestion of small

doses of the more soluble and active preparations of mercury, such as the bichloride and the bicyanide, may give rise to chronic symptoms; but these more frequently result from the administration of one or more doses of the more insoluble preparations of the metal, such as calomel or the oxides. When chronic symptoms follow the administration of one dose of a mercurial preparation, this is not altogether due to the peculiar idiosyncrasy of the patient, but is attributable in no small degree to the slowness with which mercury is eliminated from the system. There appears also to be a remarkable difference, not altogether dependent upon their differing solubilities, between *mercuric* or per-salts, and *mercurous* or proto-salts, in respect to their toxic properties. Mercuric compounds are greatly more potent than mercurous salts. By far the most common result of the continued administration of mercury compounds is salivation. This consists in a profuse discharge from the salivary glands; swelling and tenderness of the gums; and fœtor of the breath. In children, and more rarely in adults, salivation may pass into sloughing and gangrene of the cheeks; and a fatal result may ensue. Other symptoms are nausea, colicky pains, depression, and those nervous symptoms to which the term 'mercurial palsy' has been applied; but this last group of symptoms, which is most commonly met with after inhalation of the vapours of mercury, must be described more in detail.

*Mercurial Paralysis.*—Workers in mercury, such as water-gilders, looking-glass makers, and the makers of barometers and thermometers, are apt to suffer from a peculiar form of shaking palsy, known either as 'the trembles,' mercurial tremors or metallic tremors, and *tremblement métallique* by the French. This disease affects those who handle the oxides of the metal, but more frequently those who are exposed to mercurial fumes. Mercury exhibits a small vapour-tension, and consequently is vapourisable at all ordinary temperatures, but the tension of its vapour below 60° Fahr. is very small. The metallic tremors may come on suddenly or gradually, and they may be unaccompanied with salivation. The upper limbs are first affected, and then by degrees the whole muscular system. The patient is affected with tremors when an endeavour is made to exert the muscles, so that he is unable to guide, for instance, a glass of water steadily to the lips; he cannot put his feet steadily to the ground; and when he tries to walk he breaks into a dancing trot. The muscles of mastication and deglutition are affected in advanced cases. Delirium, mania, and idiocy have occasionally followed the continued inhalation of mercury fumes.

Diagnosis.—The diagnosis of mercurial tremors is usually not difficult. It must be admitted, however, that in some cases the tremors produced by mercury are in no way distinguishable from those due to the now well-recognised disease known as disseminated, multiple, or insular sclerosis. The former are less readily confounded with ordinary shaking palsy (paralysis agitans) and the convulsive movements of chorea. The history of exposure to mercury will seldom be absent. In paralysis agitans the tremors occur when the patient is at rest; and the peculiar forward gait, as if the patient were endeavouring to pass from a walking to a running pace, is characteristic. The metallic tremors come on only when the muscles are exerted, and usually they entirely cease when the patient is lying at rest, or is asleep. The same may be said of the tremors of disseminated sclerosis; but here we have the peculiar consensual rotation of the eyes known as nystagmus. In paralysis agitans, when told to raise the affected hand, or to protrude the tongue, the patient performs both actions steadily. In mercurial tremors, and in disseminated sclerosis, the case is different—the tongue when voluntarily protruded is tremulous, and the patient cannot raise his hand when requested to do so, without shaking. In both mercurial tremors and the tremors of insular sclerosis, the muscular agitation ceases for the most part during sleep. In one form of metallic tremors the movements approach in character the convulsive movements of chorea.

Treatment.—In chronic mercurial poisoning, it is obvious that the patient must at once be removed from the further influence of the metal. Masks worn over the mouth are not of much use. In mercurial tremors cessation from working with the metal, and mild tonics of iron, usually suffice for the speedy restoration to health; but the shaking occasionally persists throughout life. For salivation and the more formidable gangrene of the mouth, besides cessation of the administration of the metal, and the exhibition of tonics, iodide of potassium may be given. Astringent gargles and active local treatment may perhaps be necessary.

Thomas Stevenson.

**MESENTERIC GLANDS, Diseases of.** Of the lacteal glands, which lie in the folds of the peritoneum connected with the intestines, the mesenteric—which are connected with the small intestines—may be ranked as the most important, and what is described with regard to these will apply to the rest of the lacteal glands. They are all really of the same nature as the lymphatic glands, and are subject to similar diseases. The statements made, therefore, with reference to these structures, will also apply in the main to the lacteal glands (*see* Lymphatic System, Diseases of); but the latter are likewise liable to certain special morbid changes, whilst these changes present some peculiarities as regards their effects and symptoms. Thus, when the lacteal glands are diseased, the general nutrition tends to be markedly impaired, owing to the interference with the transmission and due elaboration of the chyle, and if they are extensively involved the entire system suffers gravely. Owing to their situation and anatomical relations, these glands, in certain forms of disease, may originate secondary effects of considerable importance. For instance, peritonitis may be excited by their irritation or rupture; or by their pressure on vessels or other structures, ascites and other conditions more or less serious may result. The enlarged mesenteric glands may be felt, in certain diseases, through the abdominal walls. With these preliminary remarks, the par-

ticular diseases of the mesenteric glands will now be considered, so far as they may require special comment.

1. **Acute Congestion and Inflammation.** The lacteal glands are very liable to become more or less congested or inflamed in connection with any inflammatory condition affecting the intestinal canal. The situation and number of glands implicated will correspond mainly with the portion of bowel involved. They become enlarged, but the changes are seldom such as to give rise to any evident symptoms, and they subside as the cause of the irritation ceases to operate. In rare instances the inflammatory process may go on to suppuration, and then there is great danger of serious consequences; in one case which came under the writer's notice, fatal peritonitis appeared to have been set up by the irritation of a suppurating mesenteric gland.

Attention may be directed here to the changes which occur in the lacteal glands in certain special acute diseases, namely, typhoid fever and dysentery. In typhoid fever the mesenteric glands are usually involved, corresponding with the part of the small bowel affected in this disease; but if the colon is implicated the mesocolic glands also suffer. The changes in the glands cannot be looked upon as merely secondary to intestinal irritation, for they commence from the outset, and go on simultaneously with the progress of the intestinal lesions. The glands become enlarged, from a hyperplasia of their lymphatic elements, and this enlargement increases until from about the tenth to the fourteenth day of the disease. They are of a red or purplish colour, and moderately firm. On section small, opaque, pale-yellow, friable collections are sometimes seen. As a rule the glands subsequently become gradually softer, and diminish in size, resuming in favourable cases their normal condition; not uncommonly, however, they become more or less shrivelled and contracted, tough and pale, or of a grey or bluish colour, and they may even calcify. In exceptional instances the glands rapidly soften in their interior, a purulent fluid being formed, mingled with sloughs; and very rarely they have ruptured into the peritoneum, thus setting up fatal peritonitis. It cannot be demonstrated how far the implication of the absorbent glands accounts for the symptoms of typhoid fever, but it is highly probable that they have more or less influence over them.

Dysentery is another special disease in which the lacteal glands are involved, but the changes here seem to be merely the effects of irritation from the intestinal lesion. The mesocolic glands are mainly affected, but if the disease implicates the small intestines, the mesenteric also suffer. They become enlarged, red, and softened; and if the dysentery assumes a chronic form, the glands are also permanently changed.

2. **Scrofulous or Tubercular Disease.**—*Tabes mesenterica.*—The nature of this affection has been already discussed in relation to the absorbent glands generally (*see* LYMPHATIC SYSTEM, Diseases of), and it will suffice to indicate here the special points which require to be noticed in connection with the lacteal glands. Scrofulous or tuberculous disease of the mesenteric glands constitutes a most important disease in children and young persons. It may exist independently, but is usually associated with so-called tubercular ulceration of the intestines, to which it is then probably secondary. It is not improbable that the mesenteric disease may be primarily set up as the result of mere long-continued chronic intestinal catarrh. The patient may be evidently scrofulous or tubercular, but this is by no means constant, and there may be no signs whatever of any such diathesis. The disease may also be accompanied with pulmonary phthisis, although this is comparatively rare in children, and the lung-affection is almost always secondary. In adults, on the other hand, tuberculous disease of the lacteal glands, when it does occur, is in the large majority of cases a complication of pulmonary phthisis, intestinal ulceration being present at the same time.

The changes in the glands are similar to those characteristic of the scrofulous process in the lymphatic glands, namely, a hyperplasia of the cellular structures, of low vitality, followed by caseation, and ultimately by calcification, if the case last sufficiently long; and it is usual in fatal cases to find these conditions more or less combined in different glands. Should recovery take place, all the involved glands may be converted into inert, chalky masses, in which condition they remain permanently. A case came under the writer's notice some years ago, in which the patient having died from an independent acute illness, the mesenteric glands were found to be universally calcified, this being associated with scarring of the external glands, and other signs of past scrofulous disease, from which the patient had quite recovered; the condition of the glands was unattended with any symptoms whatever. The individual glands in mesenteric disease may attain a considerable size, and when they are agglomerated a distinct tumour is formed.

SYMPTOMS. — It is frequently impossible to recognise definitely the symptoms, either local or general, due to scrofulous disease of the mesenteric glands, as they are combined with, and masked by those resulting from intestinal ulceration and catarrh, or from the implication of other structures. The digestive organs are usually disordered, and, even if there should not be intestinal ulceration, children who suffer from mesenteric disease are very liable to enteric catarrh. Hence diarrhœa, with unhealthy stools is a common symptom, and it is often difficult to check, or it returns from very slight causes. In other cases the bowels are constipated. Scrofulous mesenteric glands do not seem to be painful in themselves, but colicky pains in connection with the bowels are of frequent occurrence, and the diseases of the glands may have some influence in exciting these. The abdomen is almost always distended and prominent, owing to the accumulation of flatus, and it may be distinctly tympanitic. Hence, even when the glands are much enlarged, it is often impossible to feel them, but they may sometimes be made out by deep pressure with the fingers over the abdomen. In some instances the abdomen is retracted, and then the glands may be more readily felt. They may produce symptoms by their mechanical effects, and the writer has met with a case in which extreme ascites was probably due to tubercular mesenteric

disease. By irritation of the peritoneum, or, in very rare instances, by the glands bursting into its cavity, peritonitis may be set up. The general symptoms are usually very prominent, as evidenced by wasting, which may reach extreme emaciation, anæmia, debility, and pyrexia, marked hectic fever ultimately supervening in some cases. How far, however, the mesenteric lesion originates these symptoms is a matter of doubt and dispute, but it is highly probable that it is in some measure accountable for them. Cases in which mesenteric glands are the seat of scrofulous disease differ much in their severity, and it may be quite impossible to make any positive diagnosis. A large number of cases prove fatal, but it must be remembered that even after severe symptoms recovery may take place, the glands becoming calcareous and harmless. When the glandular affection is secondary to pulmonary phthisis, it helps to hasten the fatal termination.

Treatment.—This mainly consists in the treatment required for scrofulous disease in general, such as the administration of cod-liver oil, preparations of iron, quinine, and other tonics; favourable hygienic conditions and surroundings; change of air, especially to the country or to the sea-side; and other appropriate measures. The diet needs particularly careful attention. It should be nutritious and digestible, but has often to be modified so as to render it suitable for the condition of the alimentary canal. Remedies directed to the improvement of the state of this canal, or to the relief of symptoms connected with it, are also often required. No local application can possibly have any effect upon scrofulous mesenteric glands; but symptoms might be benefited by friction with some liniment, the application of a flannel bandage, or the use of dry heat, fomentations, or poultices in connection with the abdomen, should occasion call for them. Any secondary morbid conditions which may arise must be attended to. In the case already alluded to, paracentesis was urgently demanded, on account of extreme ascites; the fluid re-accumulated almost to the same amount, but it afterwards gradually disappeared entirely by absorption, and the patient recovered.

3. **Hypertrophy.**—It will merely be needful to remark under this head that the lacteal glands are liable to be more or less hypertrophied in cases of lymphadenoma, and in the form of leucocythæmia attended with glandular enlargement. The writer has met with instances where the growth was very considerable. They might possibly be detected during life by physical examination, or they might cause symptoms by their mechanical effects; but, as a rule, their existence is only ascertained at the *post-mortem* examination.

4. **Atrophy and Degeneration.**—The mesenteric glands atrophy in old age, and they may also become wasted and withered after previous disease, such as typhoid fever. The caseous and calcareous changes which they undergo in connection with scrofulous disease have been already indicated. It may happen that atrophic or degenerative changes in these glands affect the general condition; but it is certain that they may be extensively calcified, and yet the patient remain apparently in excellent health.

5. **Morbid Formations.**—The mesenteric glands may be the seat of *albuminoid* disease. It is said that they can then be felt through the abdominal walls, firm, distinct, and easily movable; but this is by no means always the case *Cancer* is chiefly met with as a secondary deposit, the lacteal glands being particularly liable to become affected if the intestine is the seat of malignant disease, and the localisation being determined by that of the intestinal lesion. It may occur, however, as a primary affection. The cancer is usually of the softer variety, but it will depend to some extent on the nature of any primary deposit. A considerable tumour may be formed, firm and nodulated; or the glands may remain separate. Physical examination often reveals the presence of the disease; and this, together with localised pain, and symptoms due to pressure, should any such be present, as well as signs of the cancerous cachexia, or of the implication of other organs, especially the intestines, constitute the clinical phenomena associated with malignant disease of the lacteal glands. No treatment can be of any service. Frederick T. Roberts.

**MESENTERY, Diseases of.** *See* Peritoneum, Diseases of.

**MESMERISM.**—Definition.—The name of the process by which, rather more than a century ago, Anthony Mesmer, the deluded (or at all events the deluding) promulgator of the doctrine of 'animal magnetism,' induced the so-called mesmeric trance or sleep. *See* Magnetism, Animal.

This mesmeric trance is identical with the condition now known as 'induced somnambulism,' or still more commonly as 'hypnotism' or the 'hypnotic state.' The condition itself is one which presents to the observer many highly interesting phenomena, and it, together with the means of inducing it, were first investigated in a full and scientific manner by James Braid of Manchester (1843).

In this place it is not intended to speak of the subject from its old point of view. The reader who desires to gain some notion of the errors, deceptions, and vain pretensions with which the whole subject was enveloped by those who have been content to style themselves 'mesmerists,' may with advantage consult the article on 'Mesmérisme,' by Deschambre (*Dict. Ency. des Sc. Méd.*, tome vii.), at the close of which they will also find a valuable bibliography. Here the proceedings of Mesmer and his followers in France are fully exposed.

As a sort of transition between this old state of things, with its erroneous theory and vain pretensions, and the scientific standpoint taken by Braid in regard to the more correct limitation of the phenomena observable and their altogether intrinsic mode of production, came the observations of Elliotson in London, as conducted in the years 1837–38, when he sought to inform himself and others as to the phenomena and curative virtues of mesmerism. He encountered a storm of opposition, principally on account of his mode of dealing with the subject. He was unquestionably honest and enthusiastic

in his search for what he believed to be truth; but he unfortunately did not, as Braid by his keener insight was enabled to do, reject and otherwise explain the so-called phenomena of clairvoyance, of transposition of the senses, and of prediction or prophecy. It is to be regretted, however, that Braid did not also reject all the so-called phenomena of phreno-hypnotism.

An independent practical study of the subject and of its therapeutic applications was shortly after the date of Braid's labours commenced by Esdaile in India (1846), as well as by J. K. Mitchell in the United States. They have more recently been succeeded by other investigators, amongst whom may be mentioned Girard Teulon and Demarquay (1860); Ch. Richet (1875); Charcot (1878); and also Weinhold, Beard, Preyer, Berger, Grützner, and Heidenhain (1880).

The induction of the hypnotic state or sleep has hitherto been possible in only a certain, but variable percentage of the persons with whom trial has been made, though a successful result has been much more frequent with women than with men. According to Richet, however, the operator should not be discouraged by the failure of his first attempts with the same person; as persons may succumb on the fourth or fifth trial, and subsequently prove thoroughly good subjects for experimentation. Persons who have once been hypnotised can in general be again brought with comparative ease into the same condition, and the facility of hypnotising such persons goes on increasing after each operation, owing to the existence of a predisposing mental state. A condition of excited expectancy is indeed a decidedly favouring mental state, though one which is not essential, since, according to Braid, Heidenhain, and others, even male adults who have heard nothing on the subject, and do not know for what purpose they are being experimented with, can often be hypnotised.

In persons who are favourably disposed for passing into the hypnotic state, the condition is easily induced by weak, long-continued, and uniform stimulation, either of the nerves of sight, of touch, or of hearing. This state is, on the contrary, almost always easily capable of being abruptly terminated by some strong or suddenly varying stimulation of the same nerves.

Many of the lower animals, such as frogs and fowls, can be thrown into an extremely similar condition as a result of certain sudden and powerful sensorial impressions. Preyer distinguishes the state into which they are thrown by a different name, namely, 'cataplexy,' because the mode, or physiological process, by which it is induced, seems to be different from that by which hypnotism is caused.

The hypnotic state or sleep is one which varies much in intensity in different persons, or in the same person at different times. The principal phenomena that are exhibited or which can be detected in hypnotized persons are the following:—(1) Imitation movements; (2) Exaltations of special sense; (3) Illusions and hallucinations; (4) Analgesia, general or unilateral, or even a condition of hemianæsthesia, general and special; (5) Increased reflex irritability and tonic spasms of the voluntary muscles; and (6) Other miscellaneous phenomena, such as spasm of the accommodation apparatus in the eye, dilatation of the pupils, increased rapidity of respiration and of the pulse, together with profuse perspiration.

A discussion of the mode of production of these several phenomena, or of the nature of the hypnotic condition itself, would lead us into details too purely physiological for our present purpose—suffice it to say that the hypnotic state, in one or other of its stages, seems to be akin to that met with in some sleeping persons, as well as to the states known as somnambulism and catalepsy, and that its physiological cause is presumed by Heidenhain to be some inhibitory arrest of activity of the ganglion-cells of the cerebral cortex, or, as the writer would rather put it, of certain tracts of these ganglion-cells. (See *Animal Magnetism: Physiological Observations*, by R. Heidenhain, 1880.)

The scientific study of the phenomena presented by hypnotized persons is unquestionably of great interest and importance, from the point of view of the higher cerebral physiology. But whether the systematic induction of such a state can ever be used as a legitimate or potent means for curing disease, or even for the alleviation of certain distressing symptoms, must be left for the future to decide. The good use to which it was put by Esdaile in India, as a means of inducing insensibility during surgical operations before the general introduction of chloroform, ought, however, never to be forgotten. (See his *Mesmerism in India, and its Practical Application in Surgery and Medicine.*) The whole subject is one of great interest for the practitioner of medicine, now that the absurd theories have been got rid of. We must be careful, however, to pursue the study of the condition itself in a strictly scientific manner, and watch lest the too-ready adoption of hypnosis or Braidism as a curative agent may do harm rather than good—and that not to the patient only, but also to the practitioner. The statements of the results obtained by Braid (see his *Neurypnology*, 1843) are little less than marvellous; and there can be no doubt that the therapeutic uses of hypnotism ought to receive a new and thorough investigation by some instructed and well-trained observers. The pitfalls besetting such an investigation are by no means few; but, on the other hand, the gains to the science of medicine and to therapeutics might be great. *See* BRAIDISM.

H. CHARLTON BASTIAN.

**MESOLOGY** (*μέσος*, a medium; and *λόγος*, a discourse).

This term, recently introduced by Bertillon, conveniently expresses the investigation of the mutual relationships existing between living beings and their surroundings.

The physiological life of any organism may be regarded as the resultant on the part of the tissues of two sets of influences—intrinsic or hereditary, and extrinsic. To the former are due those structural, and consequently functional characteristics, which are common to ancestors and progeny alike, whilst the fluctuating nature of the environment determines those variations which distinguish different species. Within cer

tain assumed limits these stimuli are regarded as normal, and the resulting manifestations of the tissues are said to be healthy; whilst disturbances in either of these groups of influences constitute the causes of disease—that is, abnormal function dependent on abnormal structure, which in its turn has been brought about by a change in the usual conditions under which it exists.

Mesology, therefore, may be looked upon in a restricted sense as a branch of ætiology, dealing, as it does, with such factors as temperature, atmosphere, climate, locality, food, clothing, and the more subtle agencies of habit, profession, domesticity, mental states of depression, excitement, or irritation; in short, with any and every circumstance, whether material or psychical, which acts upon the body. W. H. Allchin.

**METALLIC.**—A peculiar quality of sound, which the name suggests, either elicited by percussion or heard on auscultation, especially in connection with certain adventitious sounds in pulmonary cavities. *See* Physical Examination.

**METAMORPHOSIS** (*μετὰ*, a particle signifying change, and *μορφόω*, I form).—In a pathological sense this word signifies a form of degeneration, in which one tissue or substance becomes chemically changed into another, as for example, albuminous structures into fat. *See* Degeneration.

**METASTASIS** } (*μεθίστημι*, I change
**METASTATIC** } place).—These terms are supposed to imply the translation of a disease from one part of the body to another, such as seems to occur occasionally in gout, rheumatism, mumps, and certain affections of the skin and mucous membranes. Modern pathology, whilst admitting the existence of the phenomena to which the term metastasis has been applied, refuses to accept as satisfactory the explanation of the fact implied in the term.

**METEORISM** (*μετεωρίζω*, I raise up).—A synonym for tympanites. *See* Tympanites.

**METRALGIA** (*μήτρα*, the womb, and *ἄλγος*, pain).—Pain in the womb. *See* Womb, Diseases of.

**METRITIS** (*μήτρα*, the womb). — Inflammation of the womb. *See* Womb, Diseases of.

**MIASM** (*μιαίνω*, I pollute).—This term has been used very vaguely in reference to poisonous emanations generally, but its application ought to be limited to the malarial poison. *See* Malaria.

**MICROCOCCI** (*μικρὸς*, little; and *κόκκος*, a berry).—Synon.: Spherical or sphæro-bacteria; globular bacteria; *Microsporon* (Klebs); *Monas crepusculum*; Ger. *Kugel-bacterien.*

Some of these names are also used by different authors in a wider sense; and some, such as *microsporon*, have only been applied to certain species.

Definition.—Bacteria, of spherical or ovoid form, which multiply like other bacteria by transverse fission into double forms, chains, or clumps, or into large globular masses (zooglœa), in which the individual elements are densely packed, with very little intercellular substance. They do not grow into rods or filaments, thus being distinguished from bacteria proper and bacilli; and they have, according to Cohn, no power of independent locomotive movement, differing in this respect from common bacteria, which have usually alternate stages of rest and motion. The other essential generic characters are those of bacteria in general. *See* Bacteria.

Description and Physical Characters.—Micrococci are of extreme minuteness, rarely exceeding $\frac{1}{25000}$ of an inch in diameter, and often being much smaller than this. As seen with the microscope, they appear as minute highly-refractile dots; and, if suspended in fluid, are in active Brownian movement. When single, they are with difficulty to be distinguished from minute oil-globules or granules of protoplasm, but they are usually found in pairs or rows, and are then more easily recognised. As they multiply by transverse fission with extraordinary rapidity, they are usually seen in this dumb-bell shape, and moving to and fro, when in active growth. If growing more slowly in a quiescent medium, they form chains, composed of six, eight, or more members linked together. And, lastly, under favourable conditions, they grow into rounded masses consisting of an agglomeration of an infinite number of individuals, united by an intercell ar substance, the so-called

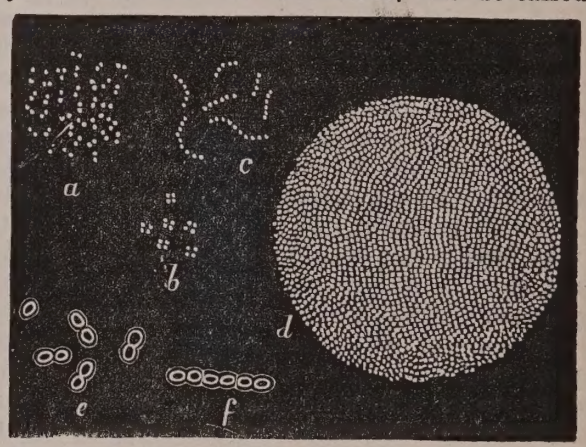


Fig. 27. *a*. Single and double micrococci; *b*. groups of four, 'sarcina' form; *c*. chains; *d*. zooglœa; *e*. single and double micrococci, more highly magnified, showing process of division; *f*. a chain, more highly magnified.

*zooglœa* (fig. 27, *d*). The various groupings thus produced have been described under various names: *dumb-bell* or *double* form, when two individual elements are incompletely separated (Fig. 27, *a*); *chain* form (*Kettenform*), *rosary* form (*Rosenkranzform*), *torula* form, *leptothrix mycothrix*, *streptococcus*, and various other names, when in rows which are straight, bent, or curved (Fig. 27, *c*). Usually, before complete separation of any two elements takes place, the fission process has commenced in these individuals, and thus a chain of four is produced, if, as is usual, the fission is transverse; when, more rarely, it is longitudinal, a group of four—*'sarcina-form'*—is produced (Fig. 27, *b*). These names are unscientific, and should be discarded, for they indicate no real difference in nature, but merely an accidental grouping.

When diffused in a clear fluid, micrococci cause an opalescence. If, however, they are in zooglœa masses, they appear to the naked eye as opaque

white dots, which may be as large as a pin's-head or more; or they may be tinged by colouring matters absorbed from the surrounding medium.

Micrococci consist of protoplasm, which, like that of other bacteria, is highly refractile, resists the action of alkalies and dilute acids, and is strongly coloured by various reagents. The protoplasm is believed to consist of an outer envelope and cell-contents. When in zoogloea masses, micrococci are united by a small quantity of intercellular substance, which may, perhaps, be produced by solution of their outer envelope. The zoogloea appears under the microscope as dense granular masses, with a finely but uniformly punctated surface.

Life-history.—Micrococci have been supposed by some to originate spontaneously by the disintegration of organised albuminous bodies; but this mode of production is denied by other observers. In their free growth they require the presence of a pabulum containing nitrogen- and carbon-compounds, and water, together with a small quantity of free oxygen; but most micrococci, if not all, grow freely in fluids from which the free access of air is excluded, and hence they belong to Pasteur's class of *anærobiæ*. The growth of micrococci is largely influenced by temperature, but the degree of heat most favourable to their germination probably varies with the different species.

Micrococci are very tenacious of life, resisting the action of heat to a remarkable degree. The exact death-point has not been accurately determined. They appear also to resist the so-called 'antiseptics' much more than other bacteria.

The relation of micrococci to ordinary rod-shaped bacteria has been a matter of dispute. It is now known that rod-bacteria, when cultivated, may produce spores, which can divide and sub-divide again, and which, in their physical characters, are undistinguishable from micrococci. So, also, bacilli produce spores, which may sub-divide, but again germinating reproduce the bacillus filaments. The question has therefore been raised, whether these micrococci are not the spores of bacteria, which have assumed an abortive stable form, and do not usually produce rod-bacteria. It has indeed been stated that bacteria have been seen to divide into micrococci. But the numerous experiments and observations made with the object of reproducing bacteria from micrococci have hitherto failed.

Classification.—Thus far micrococci have been treated as a class; it must now be stated that various sub-genera and species have been described.

Micrococci have been divided by Cohn into three sub-orders, namely—(1) *chromogenic*, those which produce in their growth soluble or insoluble colouring matters; (2) *zymogenic*, those concerned in special forms of fermentation; and (3) *pathogenic*, or those associated with disease, 'ferments of contagion.' It is the *pathogenic* alone that need here be considered.

Pathological Relations in General.—Micrococci, like other bacteria, play a certain part in putrefactive and fermentative processes, in which they are constantly present; and probably they are also in some way concerned in certain of the processes of disease in animal and vegetable organisms. Although the exact part which bacteria play must be allowed to be doubtful, there can hardly be a question of their importance in relation to some of these processes. In face of the various opinions now entertained on the subject, it can only be stated here that some believe them to be the active agents of these processes, and as a consequence that the bacterium which produces each process, whether fermentative or morbific, is specific in its nature; whilst others believe that these processes arise independently, that the bacteria are merely concomitants, and that the varieties in mode of growth and in outward form are merely the results of the various conditions under which they grow. But there is much evidence, both from the study of processes of fermentation, and of the diseases of vegetables and animals, to show that the various forms of micrococci, as of other bacteria, are more or less specific, or at least have acquired specific properties and powers.

Micrococci have been alleged to be concerned in the production of a large number of diseases, mainly those known as septic and contagious. Of the septic diseases, pyæmia, septicæmia, and puerperal fever, and of the contagious specific diseases, diphtheria, erysipelas, gonorrhœa, and vaccinia, are those in which micrococci are asserted to play an important part. There can be no doubt that they are frequently, if not constantly, present in the tissues or fluids of the body, or in the inflammatory products, in some of these diseases, but their significance is a matter of dispute (*see* Bacteria). It may be observed that the question of their action in pyæmia and septicæmia is a very different one from that of their relation to the specific diseases, such as vaccinia, and these two classes of disease may therefore be considered separately.

*Special pathology in relation to blood-poisoning.*—With regard to the septic diseases, especially pyæmia, the evidence of the action of micrococci is partly derived from general consideration, partly from anatomical observation, and partly from experiments on the lower animals.

Micrococci are known to be present in nearly all decomposing animal fluids, and, on the other hand, the experiments of Lister and others tend to show that if precautions are taken to exclude bacteria, especially micrococci and bacterium termo, putrescence does not occur. Micrococci are hence regarded as the ferments of putrefaction, or, rather, of one form of putrefaction. The evidence that pyæmia is produced by the inoculation of some putrescent animal matter is very strong; and the exclusion of the ferment of putrefaction has apparently the same effect. Micrococci are also found in the pus or serum of nearly all active poisoned wounds, commonly so called, such as 'necrotic warts,' whitlows, &c., and frequently in the pus of acute abscesses, (Birch-Hirschfeld, Alex. Ogston, and others); and there is much evidence to show that the infective property of the pus of abscesses is dependent on, or co-existent with, their presence, inoculation with fresh pus containing them producing suppuration, but in their absence no such effect being observed. When artificially cultivated in nutrient fluids this property of

causing suppuration may be lost, especially if there is free access of air; but A. Ogston has succeeded in cultivating them in eggs, excluding the air, and in thus multiplying micrococci which retain their power of causing suppuration. This is also in accordance with numerous experiments, which have proved that decomposed blood, containing abundant micrococci, may be inoculated with impunity, showing that either only *certain kinds* of micrococci have phlogogenic or septic properties, or that certain conditions of growth are necessary to confer or maintain those properties.

Anatomical observations on pyæmia, both in man and in the lower animals, have shown that micrococci are almost constantly present in the affected parts. The first observations on this point are probably due to Klebs, who described the *microsporon septicum* as found in pyæmia, and cultivated it outside the body. Many observers have since confirmed his results, with some variations in detail. Zooglœa masses of micrococci are found in the capillaries, and capillary arterioles and venules, the latter especially, of various organs—the lung, kidney, heart, liver, and thymus in particular. Moreover, their presence in these viscera usually coincides with the presence of abscesses in course of formation in these situations. They are also found in the submucous tissues, and the serous cavities, lymphatic glands, &c. In pyæmia in the lower animals, micrococci are often found in large numbers in the blood. Nor is it only in pyæmia, commonly so-called, that this constant presence of micrococci is observed; in many other allied diseases associated with blood-poisoning similar observations have been made. Thus, in puerperal fever (Heiberg), hospital gangrene, ulcerative endocarditis, diphtheritic endocarditis (Weigert), &c., they have been found, both in the primary lesion and in the secondary abscesses. As to their mode of action, apart from the general results of putrid fermentation, micrococci appear in some cases to produce local effects, such as dilatation of the walls of vessels, or thrombosis by their action on leucocytes, and local irritation and its consequences. Moreover, it would appear from the researches of Koch, who produced various forms of blood-poisoning and gangrene in rodents, that micrococci may have different actions in different forms of these diseases, and that in their physical characters and grouping, as well as in their local action, these micrococci may show differences sufficient to constitute distinct species, each having a specific action, and producing a special form of disease, whether pyæmia, septicæmia, or gangrene. By many other observers, however, the specific dintinctness of these different forms is altogether denied. For fuller details the writings of Hiller, Klebs, Billroth, Pasteur, Lister, Burdon-Sanderson, Watson-Cheyne, and many others, may be consulted.

Against these observations the objection has been raised that micrococci are capable of development in the body in lowered conditions of vitality, or even of spontaneous generation from disintegrating albuminous substances, both after death and during life when death is approaching; and that they are merely evidence of a change allied to decomposition *intra vitam*. That the healthy organism has a great power of resisting their entrance, and of destroying them when artificially introduced, must be considered an established fact; but there are so many channels by which they may enter if the power of resistance is lowered, that a spontaneous generation must not be assumed too readily to explain their presence. Experiments made by feeding animals with phosphorus, and thus lowering their vitality, clearly show that micrococci do appear in the blood under these conditions. Many experiments have been made to determine whether micrococci and bacteria exist normally in the blood and tissues, held in check only by the vitality of the organism, so that after death they germinate. Recent experiments, notably those of Billroth, Tiegel, Burdon-Sanderson, Chiene and Ewart, Nencki and Giacosa, and Watson-Cheyne, have led to very different results, partly due to differences in method; but the question must be considered to be at present undecided.

*Special pathology in relation to specific contagious diseases.*—The subject of the relation of micrococci to specific contagious diseases, such as diphtheria and vaccinia, is too wide for complete discussion here. By some each of these diseases is believed to be dependent on the action of a particular specific micrococcus constituting its contagium and virus; and by the multiplication of these micrococci, and the pathological changes consequent thereon, the disease is supposed to be produced and propagated. Of the 'pathogenic' micrococci which have been described, the most important are the *micrococcus diphtheriticus* and *micrococcus vaccinæ*. The micrococcus of diphtheria has been described by Eberth, Nassilloff, Weigert, and others, and they have insisted on its constancy and importance. On the other hand many good observers have failed to find it in well-marked cases; and it must be allowed that micrococci are most abundant in the tonsils and pharynx and other parts most prone to sloughing, and are far less constant in the larynx and trachea. Their presence in decomposing false membranes is probably of no significance. The *micrococcus vaccinæ* of Cohn, Burdon-Sanderson, and others has no doubt a real existence—that is, micrococci are commonly found in vaccine lymph; but the experimental evidence that they constitute the contagium is negative.

It appears unnecessary to refer in detail to many other supposed pathogenic micrococci which have been described in relation to small-pox, horse-pox, glanders, gonorrhœa, and other affections, for the evidence upon which their existence is asserted is, to say the least, extremely imperfect. All that can safely be affirmed is that micrococci are to be found in great abundance in the pathological excretions and secretions of certain contagious diseases, especially when, as in diphtheria, these have a tendency to become putrid; and that they are usually also present in the active virus of inoculable diseases, for example, vaccinia; but whether they constitute the actual contagium, or by their action produce a local condition which is favourable to the absorption and activity of the virus, is at present uncertain.

W. S. Greenfield.

**MICROSCOPE in MEDICINE.** — The exact position of the microscope in medicine has, like most other instruments of research, not been always clearly recognised. Over-estimated in its value by the enthusiast, it has suffered from an undue exaggeration as to its capabilities, second only to that unfair depreciation put forward by ignorance of its use. Whilst perhaps representatives of both views may be found at the present day, the time has come, after nearly half a century of experience, to define with moderation the limits of its application.

It must at the outset be recognised that the microscope is but an aid to one of our senses. It merely extends our means of observation, of seeing what is. The range of our vision being limited, this optical arrangement permits a wider field, a greater depth of perception. Of itself the microscope allows the hitherto hidden, only because too minute, to be seen, whilst it discloses nothing that does not already exist; it renders, in short, the eye for the time being and in one direction more perfect.

The formation of a diagnosis, which may be regarded as the first aim of practical medicine, is the result of a judgment founded upon observation of the case, guided by experience and with due regard to external circumstances. Any agent that may extend the means of observation, or render such more accurate, is obviously a great gain; and on this ground the microscope ranks with the stethoscope, the thermometer, and the probe, which permit a wider application of the senses of hearing and touch. But whilst perhaps it may be conceded that the microscope for daily practice is not of such necessity as either of those instruments, it has a further and greater claim on the consideration of the medical man, for what it has done and is doing in laying the foundation of the science on which his practice depends.

That which characterises the theories of pathology at the present day, and which markedly distinguishes them from any and all hitherto taught, is the recognition of the association and dependence of function upon structure, with the subsequent corollary that disease is but altered function due to altered structure. Whilst the knowledge of the structure of the body—anatomy—was, previous to the present century, of the grossest character, the theories of disease were limited only by fancy and empiricism. But as the great truth which established the connection of physiology, and hence of pathology, with anatomy came more and more to be recognised, the principles of morbid action, the explanation of symptoms, and the suggestion of rational treatment followed on truly scientific grounds. It was in establishing, and is now in maintaining and following this truth, that the microscope ranks highest among our instruments of research.

The Instrument.—In face of the many and excellent instruments that are offered, it would be invidious to recommend any particular one; but the following remarks are intended to be a guide as to the kind of microscope that is sufficient for the ordinary requirements of the practitioner, it being assumed that the optical principles of a compound microscope are understood.

Obviously the first point to keep in view is the *magnifying power*, inasmuch as it is to bring within the range of vision invisible objects that the instrument is valuable. For all ordinary practical purposes a power that will magnify 300 to 400 diameters is sufficient; higher degrees require specially skilled manipulation, and are out of the category of present consideration. But at the same time it is almost an essential that a much lower power be available, such as one of 60 diameters, in order that a more general view may be had of the object under examination, since it is thus that an idea may be obtained of the plan and arrangement of the object, the details of which are resolved by the higher power. Scarcely secondary in consideration is the 'defining power,' by which 'a clear and distinct image of all well-marked features of an object, especially of its boundaries,' is obtained (Carpenter). Subordinate to these qualifications, but yet of great importance, are 'flatness of field,' 'achromatism,' 'penetration,' and 'sufficient light.' Excellence in these various points is to be aimed at in the selection of a glass. The whole field of vision should be flat, that is, the circumference and the centre should be in focus at the same time; and the margins of the object viewed should not be fringed with coloured bands. Errors in these directions, known as spherical and chromatic aberrations, are corrected by the employment of 'combinations' of lenses, of varying degrees of convexity, and manufactured of different kinds of glass. It is clearly of great importance to have the field well illuminated, or that there be as much light as possible, but it is equally obvious that this necessarily varies with the focal length of the object-glass—the higher the power the less the light that can be admitted. Still, however, a considerable difference exists in respect to the illumination among glasses of the same magnifying power, and it is highly desirable to keep this point in view in choosing an objective. Certain aids to this end are given by reflectors, achromatic condensers, &c. With the degree of 'illuminating power' of the glass must be considered its 'penetrating power or focal depth, by which the observer is enabled to *look into* the structure of objects' (Carpenter). The latter quality is of the utmost importance in the microscope of the medical practitioner and histologist, as by it a knowledge is afforded of the relative disposition of the constituent parts of the object under investigation. All these properties are closely associated with what is known as the 'angular aperture' of the objective, that is, 'the angle formed between the most external rays that can penetrate the entire system of lenses of an objective, from a luminous point placed in the focus.' Now the degree of angular aperture will depend on the distance of the object, when in focus, from the front lens of the objective, and the size of the 'actual aperture,' or width of the front lens of the combination. The illumination of the object must be directly proportionate to the latter, since upon the actual size of the lens must depend the amount of light admitted; but since the circumferential and central rays tend to come to a focus at different points, to the manifest detri-

ment of the distinctness of the image, the defining power of the glass will be improved as the outside rays are cut off by diminishing the field, or, in other words, by diminishing the amount of light. Within certain limits, therefore, the definition improves in inverse proportion to the illumination, always assuming a complete correction of chromatic and spherical aberration. Now the 'penetrating power,' within certain limits, varies in inverse proportion to the extent of angle of aperture of the objective, which, as already said, in part depends on the size of the actual aperture. Hence also the penetration up to a certain point improves in inverse proportion to the illumination. Since it is impossible to reconcile these very opposite qualities, the observer must be prepared to lose somewhat in light what he gains in distinctness and depth of his image; and, as a rule, the angular aperture of the $\frac{1}{4}$ should not exceed 75°, nor of the $\frac{1}{6}$th or $\frac{1}{8}$th, 90°. The so-called 'resolving power' of a glass, 'by which closely-approximated markings may be distinguished,' is of but little value to the medical practitioner.

Keeping in mind these points, it is possible to obtain a microscope for a very moderate cost (£6 to £7), which shall fulfil all the ordinary requirements of the medical man. The stand should be small and perfectly steady, on the tripod or horseshoe (Hartnack) model. The stage should be tolerably large (a common fault is its small size), and its aperture of moderate size and provided with a wheel of diaphragms; whilst the addition of an achromatic condenser is most desirable. The mirror itself should be double, concave on one side and flat on the other, attached to the body by a jointed arm, and not too small—another fault in cheap instruments. The body of the microscope should be so attached to the stand as to permit of inclination to any angle between the vertical and horizontal positions, and should be provided with a 'draw tube.' In order that the tube carrying the optical arrangements, eye-piece and objective, may be brought into proper position to focus the object, it is usually provided with 'coarse' and 'fine' adjustments, though these are not always both present in the cheaper instruments, and are really not absolutely necessary for the powers here recommended, being moreover worse than useless unless they are exceedingly well made, which adds considerably to the expense, whilst a little practice will render the observer independent of them; if one only be available, the finer should be preferred. Lastly with respect to the glasses, a great diversity of opinion exists, very much determined by what the individual is accustomed to; familiarity with a special instrument and its parts going a great way to ensure success in its employment. Whilst probably the very best glasses, and those of the highest power (1-25th and 1-50th inch) are made in England, excellent objectives are made in Germany and France, are amply sufficient for medical practice, and give a nearly equivalent result at a much lower cost. The cheapest English glasses should certainly be avoided. For a low power a 1-inch or $\frac{2}{3}$-inch is sufficient, and anything lower is of little use; whilst for a high power opinions differ in regard to a $\frac{1}{4}$, $\frac{1}{6}$, or $\frac{1}{8}$ (or the foreign equivalents), depending much on the quality and maker of the glass. The writer believes that for all ordinary purposes the English $\frac{1}{4}$-inch is sufficient, if used with a No. 2 or B eye-piece, giving a magnifying power of about 320 diameters, whilst it has the great advantage of permitting considerable illumination, the want of which is especially felt by the occasional observer, whilst to one more familiar with the instrument the loss of light is but little felt, as magnifying power and definition are increased.

For testing the optical properties of the glasses, nothing is better than a drop of fresh blood and a piece of muscular fibre; and both the A and B eye-pieces should be tried with each objective.

Drawing.—It is frequently necessary that an accurate drawing should be made of the object seen, and this may be done by means of the camera lucida prism, attached to the eye-piece of the microscope, which is then placed horizontally. The rays of light proceeding from the object along the tube to the eye-piece are then projected downwards by the prism, on to the paper beneath, forming an image which may be traced over. An arrangement with a piece of neutral tint glass is supplied, which answers all the purposes of a camera lucida, and is much cheaper. Considerable practice is, however, needed in the use of these instruments.

Measuring.—For purposes of measuring microscopical objects various forms of micrometers are employed. One kind fits into the eye-piece; and another consists of a ruled glass slip, a drawing of the lines on which is made by the aid of the camera lucida with each objective—such drawing being afterwards used as a measure to be applied to the outlines previously made by the prism.

Binocular Microscope.—The binocular arrangement of the microscope, though undoubtedly possessing great advantages as regards penetrating power, is not of such value for ordinary clinical purposes; and, necessitating as it does the very best construction, is only applicable to the larger and more expensive instruments. A very convenient accessory when well made is the 'nose-piece,' which carries the two objectives, and thereby saves much trouble. For powers higher than the $\frac{1}{4}$, it is not satisfactory with the smaller microscopes.

Apparatus and Reagents.—Bearing in mind that it is for the clinical use of the instrument, rather than as a means of histological research, that the microscope is here considered, the actual reagents and apparatus required are very few. The following are requisites:—A pair of small curved scissors; a pair of fine pointed forceps; a few sharp needles, mounted in handles, those with cutting edge being preferable; slides and cover-glasses, which latter cannot be too thin; several camel's-hair brushes; one or two glass rods; and pipettes. Except for the examination of tumours and new growths, which may require hardening and staining, the medical man chiefly wants a microscope to ascertain the nature of various secretions and discharges, which are mostly of a fluid nature, and do not require the addition of any medium; but should any such be needed, it is desirable that it should be inert, and as nearly as possible of the

density of the blood-serum with which the tissues are normally moistened. For that purpose a 3 or 4 per cent. solution of chloride of sodium, or a 3 per cent. solution of glycerine in distilled water, to which a few crystals of carbolic acid have been added to prevent the growth of fungi, is most convenient. For hardening portions of tissue to allow of cutting sections, solutions of chromic acid ($\frac{1}{2}$ to 1 per cent.); of bichromate of potash of the same strength; of chromic acid and spirit ($\frac{1}{2}$ per cent. to 90 per cent.), distilled water to 100; and Müller's fluid—a solution of bichromate of potash ($2\frac{1}{2}$), sulphate of soda (1), distilled water (to 100); are the most effective, and are easily made. It is necessary to remember that a very considerable quantity of such fluid is required, and that it requires renewing daily for the first three days. For a piece of tissue of the size of a filbert, at least four ounces of either of the above is requisite. Under favourable circumstances the hardening is complete in 14 to 21 days. By means of the freezing microtome perfectly fresh tissue may be cut and examined.

Among the very many methods recommended for hardening and staining portions of tissue, the following is given as an extremely ready and, on the whole, easy plan. Small pieces of the substance, of about the size of a large pea, are placed in spirit for at least twelve hours to get rid of the water; they are then transferred to a solution of magenta in oil of cloves, to stain. The time required for staining varies with the tissue, the size of the piece, and the strength of the solution; but usually twenty-four hours is sufficient. The pieces are then removed to a bottle containing melted cocoa-butter, and kept there for twelve hours. The heat of the chimney-piece suffices to keep the butter melted. One of the portions is now put on the end of a small cork, to which it becomes attached by the setting of the cocoa-butter in about a couple of hours, and may then be cut with a razor, wetted with spirit in the ordinary way. The sections are floated on to a slide, the superfluous spirit removed by blotting-paper; and a drop of oil of cloves let fall on the specimen; which is covered with a covering-glass, and finally gently warmed for a minute over a spirit-lamp to dissolve out the butter. Such a specimen may be preserved by the addition of a little chloroform-balsam to the edge of the cover-glass.

Clinical Uses.—The microscope may be applied to the investigation of the various discharges and secretions from the body, with the result of obtaining information, which though often of but imperfect value, may on other occasions be of the most positive and precise character, determining a diagnosis which without it would be uncertain.

(A) Urine.—It may be taken as a fundamental principle that perfectly healthy, fresh urine should have no visible deposits. A small quantity of flocculent mucus, entangling a few epithelial cells, is, however, of such frequent occurrence and of such trifling importance as practically to come within the limits of health. More than that is abnormal, and such deposits demand investigation. It may be that they are only the result of changes in the urine after it is passed, or, on the contrary, they may have been voided as such. Occasionally absolutely clear-looking urine may contain tube-casts, which the microscope only can detect.

It is important, therefore, to know the age of any sample of urine that is examined, and when possible, a portion of the whole twenty-four hours' quantity should be taken. Where this cannot be done, what is passed in the morning on rising should be chosen, since it is in such a specimen that certain matters are most likely to be present. Frequently an examination for several successive days may be necessary, for there are some conditions of kidney-disease in which but very few casts are passed, and would most probably escape one examination of a haphazard specimen. The urine should be collected in conical glasses, holding about four ounces, which must be scrupulously clean, and, if in frequent use, are best kept in a closed vessel of water, since thereby dust is prevented from accumulating at the bottom; and it is well to pour a little strong nitric acid into such glasses occasionally, to effectually remove all dust and deposits, subsequently, of course, thoroughly washing them in cold water. The urine should be allowed to stand six or eight hours at least, and be covered by a plate of glass or a paper cap, to prevent the entrance of dust. With a clean glass pipette a few drops of the lowest portion of the fluid may be removed. A collecting-glass has been recently invented whereby the lower strata of urine may be drawn off from the bottom by a tap; but a pipette answers all ordinary purposes. It is convenient to have the glass slide to which the drops are transferred provided with a cell, made by a very thin circle of gold size, since not infrequently large casts are crushed by the pressure of the cover-glass. The cell also answers the purpose of confining the fluid, any excess of which can be removed with blotting paper. Such an arrangement is not suitable when it is required to add any reagents to the specimen.

A preliminary examination with the lower power is occasionally desirable, but it is with the higher power that a knowledge of the nature of any deposit that may be present is obtained. The following objects may occur, the clinical significance of which is treated of elsewhere:—

1. *Adventitious matter, dust, &c.*—Even with the greatest care in collecting and preparation, foreign bodies are extremely apt to be met with, the commonest of which are hairs, wool, cotton and flax fibres, minute particles of wood, starch-granules, sand, and oil-globules. Besides these, a number of extraneous substances may occur, such as sputum and fæces, the source of which is obvious, whilst occasionally substances are purposely added to deceive the observer. It is absolutely essential that an acquaintance with the microscopic appearance of all such objects be possessed by the medical man.

2. *Mucus.*—This material presents itself as finely granular streaks and smears of every variety of size and shape, often mistaken for casts, and occasionally simulated by scratches on the slide or cover-glass.

3. *Epithelial cells.*—These may be derived from all parts of the urinary tract; and they include glandular spheroidal or polyhedral cells,

from the kidney, especially the convoluted tubules; columnar cells from the ureter and the greater portion of the urethra; and flattened tesselated scales from the pelvis of the kidneys, and the orifice of the urethra. Very large cells of the same variety come from the vagina. The vesical epithelium is very variable in appearance, but is generally either flattened or pyriform, of large size, and not always to be distinguished from the scales from other parts.

4. *Spermatozoa.* — Spermatozoa occasionally occur in the urine, without being of serious importance. Their characteristic appearance is not easily recognised under a magnifying power of less than 300 diameters.

5. *Blood.*—Blood-corpuscles in the urine differ considerably from their normal biconcave disc shape, and usually shrink into irregularly-shaped particles, but they may swell up and become globular in appearance, these changes being due to alterations in the density of the fluid. Under such circumstances the corpuscles are not very easy of detection, and if but very few in number, may not always be recognised with certainty, especially as there are many other objects, such as spores of fungi, which closely resemble them. If the blood be present in moderate quantity, it gives a characteristic colour to the urine, which suggests the presence of corpuscles. The discs more rapidly disappear in alkaline than acid urine, remaining in the latter for a considerable time.

6. *Leucocytes.*—Bodies identical with white blood-corpuscles are sometimes seen entangled in the shreds of mucus (mucous corpuscles), or may be derived from the epithelial surface; and, if present in large amount, constitute pus-corpuscles, originating from pyelitis, cystitis, urethritis, leucorrhœa, rupture of an abscess into the urinary tract, and other conditions.

7. *Portions of new growths.*—Cells, fibres, and other elements, from cancerous and other neoplasms of the urinary organs or adjacent structures, such as the uterus and the rectum, may be detected in the urine; but it is very seldom that the diagnosis of the existence of these new growths rests upon their recognition under such circumstances.

8. *Renal tube-casts.*—The appearances, nature, and origin of these bodies have been fully treated of in the article Casts.

9. *Living organisms.*—The urine after standing, at the onset of the alkaline fermentation, contains bacteria and vibriones, with their characteristic vibrating movements; sometimes, also, various forms of torula and even sarcinæ, the former often in association with diabetes in acid urine (*Torula cerevisiæ; Penicillium glaucum*). Certain entozoa are found in the urine, the most important of which is the *Bilharzia hæmotobia*, a trematode worm, which causes a peculiar form of endemic hæmaturia. The ova are about $\frac{1}{170}$th inch in length, of oval form, and terminating in a spine: empty egg-shells and flask-shaped ciliated embryos are present in large quantities in the urine of patients suffering from this affection, together with blood and pus. Hooklets and fragments of *echinococci* from rupture of hydatid cysts into the urinary passages may sometimes be detected in the urine.

10. *Fat.*—In the condition known as chyluria, large quantities of fat in a state of fine molecules and minute globules, with a few leucocytes and red blood-corpuscles, are seen by the aid of the microscope.

11. *Salts.*—(α) *Amorphous.*—During the so-called 'acid fermentation,' which takes place within a few hours after the passage of normal urine, *urates of soda, potash,* and *ammonia,* and occasionally of *lime* and *magnesia,* are thrown down as a granular amorphous deposit of a brick-dust appearance; and later, during the 'alkaline fermentation,' *phosphate of lime* is precipitated in a similar condition, but of a white colour. Microscopic examination is useless to distinguish such substances, which require treatment with heat or reagents for their detection.

(β) *Crystalline.*—*Uric acid,* which in excess forms the cayenne-pepper-like grains, or gravel, is multiform in its microscopic appearances, presenting as it does typically six-sided plates, and four-sided rhombs, but often ovoid, barrel- or comb-shaped. Owing, to the affinity of the urinary pigments for uric acid and its salts, such crystals are usually slightly tinted—straw colour to pale brown; and they are very frequently aggregated into masses, and of the greatest diversity in size.

*Oxalate of lime,* found in both acid and alkaline urine, especially after the ingestion of rhubarb, tomatoes, and certain other articles of food, occurs as octahedra, or more rarely as very perfect dumb-bells, the former being composed of two four-sided pyramids placed base to base, appearing when seen in the short diameter as a square marked by two bright cross lines.

*Triple* or *ammonio-magnesian phosphates* are deposited in alkaline urine as triangular prisms with bevelled ends, and differing in length; when very short simulating the oxalate of lime octahedra. Stellate crystals of the same substance have been seen.

*Phosphate of lime,* though usually amorphous, occurs sometimes as crystals arranged in very characteristic rosettes.

*Carbonate of lime,* of very rare occurrence, appears as small spheres.

*Leucin* occurs as yellowish, highly refracting spheres, almost like oil-globules, and as needle-like scales. *Tyrosin* assumes the form of tufts of very fine needles. *Cystin* appears as regular hexagonal tablets of various size, frequently laid one on the other. *Hæmatin,* derived from the blood-pigment, has been found in minute acicular crystals in the urine of cases of hæmatinuria.

For the simple detection of most of the above-mentioned objects no reagents are necessary, the urine itself being sufficient; but the more transparent bodies, such as casts and epithelial cells, are often rendered easier of detection by slightly tinting the field with a drop of magenta solution or tincture of iodine. The crystalline deposits may be preserved by mounting in Canada balsam, subsequent to washing in spirit and turpentine; but attempts to keep for any time casts, or epithelium, are usually very unsatisfactory, though occasionally successful in very weak glycerine solution.

(B) **Fæces.**—It is not often that the matters passed by the bowel are submitted to microscopic examination—not so often perhaps as they should be. The greater part of the motions appears to consist microscopically of amorphous granular flakes of no special character; these are for the most part the degenerated dead epithelial cells shed from the mucous membrane.

Amongst the distinctly recognisable normal objects are starch-granules, oil-globules, shreds and fibres of vegetable tissue, and also of yellow elastic tissue, and not infrequently leucin, tyrosin, and cholesterine crystals. Various fungi, blood- and pus-corpuscles, crystals of triple phosphates, and ova of entozoa, are among the most important abnormal objects that may be met with.

To investigate these it is merely sufficient to flatten out, by means of slight pressure on the cover-glass, a small portion of the motion, in a drop of dilute glycerine. Both powers should be employed, since many of the fragments are easily recognised when magnified sixty or eighty diameters.

(C) **Vomit.**—This should be examined as soon as possible after expulsion, and the liability to the presence of all kinds of extraneous matter should be borne in mind. Small portions may be spread out in dilute glycerine; or it may be necessary to shake up the matter with distilled water, and take up a few drops of the mixture with a pipette.

It is impossible to give any accurate description of the appearances of the various kinds of partially digested food; but besides the characteristic starch-granules and the gastric epithelial cells, there are certain bodies which it is often of importance to be able to recognise, such as torulæ and sarcinæ, blood-corpuscles, and cancer-cells.

(D) **Sputum.**—In the examination of the expectoration the microscope is often of great value, as thereby the exact nature of the condition of the lungs may be declared. Small shreds of the sputum should be separated and spread out on the slide, and covered at once; sometimes a drop of dilute glycerine is required. It is obvious that the expectoration is liable to contain all kinds of objects that have not come from the lungs—fragments of food, epithelial scales from the tongue and mouth, hairs, &c.—but, excluding all such bodies, the sputum consists of a menstruum of viscid mucus, which is hardly recognisable under the microscope, except as a very finely granular film, entangled in which are innumerable air-bubbles of all sizes, with a few leucocytes (mucous corpuscles), and occasionally a few ciliated epithelium-cells from the air-passages. If a drop of acetic acid be floated in beneath the cover-glass, the mucus assumes a finely striated appearance, and the nuclei of the cells are rendered very distinct. With all degrees of catarrh and inflammation of the mucous tract the number of leucocytes becomes more and more abundant, with occasional red blood-corpuscles and oil-globules, the latter often aggregated into spheroidal masses. Black particles, due to inhaled soot, or coal or metallic dust, or else derived from the pigment of the lung-tissue, are present in varying amounts. When the lung is actually breaking down, fragments of pulmonic tissue may be readily recognised under the microscope by the characteristic elastic fibres, which are rendered especially distinct by the addition of acetic acid, or by previously boiling the sputum with solution of caustic soda (20 grains to the ounce), which clears up other matter, leaving the elastic tissue untouched. Vegetable fibres derived from the food, and which also resist the action of the alkali, must not be mistaken for the lung-tissue.

Among other objects which an examination of the sputum may reveal are crystals of cholesterine from caseous matter, blood-crystals, portions of new growths, as cancer-cells, bacilli, and hooklets of echinococcus.

(E) **Blood.**—By an examination of a drop of blood under the high power, the relative and actual numbers of the red and white corpuscles, their character, and the presence of abnormal objects, may be ascertained. The method of estimating the number of corpuscles is fully detailed under the heading HÆMACYTOMETER. The recognition of leucocythæmia to a great extent depends upon the microscope, by which the excess of white corpuscles is at once manifested.

The red corpuscles are apt to undergo alteration in shape, such as shrinking, or crenation, but it is not always easy to determine how far such may be the result of the preparation of the specimen.

Living organisms are occasionally found in the blood—*bacillus*, *spirilla*, &c.—associated with certain septic states, such as malignant pustule and relapsing fever. For their detection a higher power is needed, and no satisfactory investigation of such bodies can be made without a power of 700 diameters. A small nematoid worm, the *Filaria sanguinis-hominis*, about $\frac{1}{75}$-inch long and $\frac{1}{3000}$-inch broad, has also been found in the blood. *See* FILARIA SANGUINIS-HOMINIS.

To examine the blood it is sufficient to prick the finger, apply with the small forceps a clean, dry cover-glass to the wound, and gently place it on the slide, interposing a hair at the edge to prevent the corpuscles from being crushed. It is necessary to have enough blood to form a complete film, as otherwise it dries very quickly and alters in appearance, whilst if there be sufficient, the edge alone will dry, and prevent the central part from evaporating.

(F) **Milk.**—A drop of milk placed on a slide and covered with a thin glass, discloses on examination fatty granules and globules of all sizes, with sharply-defined outlines, and kept separate from one another by being surrounded by invisible films of transparent casein. In the milk secreted immediately after delivery will be seen colostrum corpuscles.

(G) **Morbid Discharges.**—The microscope is frequently of value in examining discharges from surfaces—for instance, in leucorrhœa; or from abscesses which may have burst. In the latter cases, besides the pus-cells, fragments of tissue may be seen, indicating the situation of the abscess; or the existence of a new growth may be manifested by the escape of small portions in the discharge.

(H) **Contents of Cysts.**—These are for the most part fluid or gelatinous, and leave very

little for microscopic examination. Exception must be made to the echinococcus hooklets of hydatid cysts, the fatty matter of sebaceous cysts, and cholesterine crystals, so commonly met with in ovarian, and indeed in all forms of cysts.

(I) **New Growths.**—The microscopical characters of tumours are fully described under the heads of CANCER and TUMOURS.

(K) **Adulterations of Food, Drugs, &c.**—By means of the microscope many impurities and adulterations may be discovered, which would otherwise remain unrecognised. The following substances which are extensively used—namely, starch of various kinds, improperly added to cocoa and mustard; leaves of willow or plum, substituted for tea; chicory, a root of a species of dandelion, mixed with coffee; sand with sugar; red lead with cayenne pepper; and many pigments—indigo, venetian red, umber, turmeric; as well as different salts, sulphate and carbonate of lime—are at once detected under the microscope, and many of them in this way only.

(L) **Medico-Legal Inquiries.** — Stains of blood, semen, &c., on clothing. The spots should be moistened with a few drops of distilled water, or, better still, a $\frac{1}{2}$ per cent. solution of chloride of sodium, and scraped with a sharp knife; and the fluid then transferred to a glass slide, and examined in the usual manner. The microscopical characters of spermatozoa and blood have been already referred to.

(Consult *The Microscope*, by Dr. Carpenter; *How to work with the Microscope*, and *The Microscope in Clinical Medicine*, by Dr. Beale; *Practical Histology*, by Professor Rutherford; and *A Course of Practical Histology*, by Professor Schäfer.)

## DESCRIPTION OF FIGURES.

Fig. 28.—Red blood-corpuscles—human: × 350.
*a*. Normal, singly and in rouleaux. *b*. Shrunk from treatment with concentrated fluid. *c*. Distended and globular from absorption of water. It is in this condition that the red corpuscles are most apt to appear when mixed with various fluids of the body.

Fig. 29.—Scaly epithelial cells from mouth, vagina, &c. × 200.

Fig. 30.—Leucocytes. Pus, mucous or white blood-corpuscles. × 350.
*a*. Normal. *b*. After treatment with acetic acid; nuclei very apparent. *c*. Distended and rendered transparent by water.

Fig. 31.—Ciliated epithelial cells from air-passages. × 200.

Fig. 32.—Cotton fibres, showing characteristic twist. × 100.

Fig. 33.—Milk showing colostrum corpuscles and oil-globules, the latter very variable in size, and with a sharply defined outline. × 200.

Fig. 34.—Particles of vomited matter. × 250.
*a*. Starch granules, showing characteristic concentric lines. *b*. Fragments of partially digested muscular fibre.

Fig. 35.—Epithelium from urinary tracts. × 200.
*a*. From renal tubules; glandular. *b*. From ureter and urethra; columnar. *c*. Vesical.

Fig. 36.—Spermatozoa; human. × 350.

Fig. 37.—Fragments of hair. × 100.
*a*. Cortex. *b*. Epidermis. *c*. Medulla.

Fig. 38.—Sarcina ventriculi. × 250.

Fig. 39.—Hooklets of Echinococcus. × 250.

Fig. 40.—From phthisical sputum, showing elastic fibres of lung-tissue and leucocytes. × 350.

Fig. 41.—Hæmin crystals from old blood-clot. × 250.

Fig. 42.—Cubes of chloride of sodium. × 200.

Fig. 43.—Leucin. × 120.

Fig. 44.—Tyrosin. × 120.

Fig. 45.—Uric acid, various forms. × 120.

Fig. 46.—Cholesterin plates. × 120.

Fig. 47.—Cystin. × 120.

Fig. 48.—Oxalate of lime; dumb-bells and octahedra. × 120.

Fig. 49.—Triple or ammoniaco-magnesian phosphate. × 120.

Fig. 50.—Torula cerevisiæ; yeast fungus. × 350.

Fig. 51.—Sputum of early pneumonia, showing red blood-corpuscles and leucocytes. × 300.

Fig. 52.—Shreds of elastic tissue in sputum of phthisis. × 300.

Fig. 53.—Oïdium albicans; thrush. × 300.

Fig. 54.—Penicillium glaucum. × 300.

W. H. ALLCHIN.

**MICROSPORON** (*μικρὸς*, small, and *σπόρος*, a spore).—The fungus-plant of phytosis or tinea versicolor; also named epidermophyton. *See* EPIPHYTIC SKIN-DISEASES; and SKIN, Diseases of.

**MICTURITION, Disorders of.**—Under this term will be considered those conditions which interfere with the normal performance of micturition, regarded as a physical act. Thus suppression of urine is not included in this category, for in the state so described, the urine is not secreted by the kidney, and the absence of the secretion is not due to any physical cause in the bladder or urethra. The following will be treated of as disorders of micturition:—

1. *Irritability of the bladder in the adult.*
2. *Diminished size of stream.*
3. *Retention of urine, partial* and *complete.*
4. *Urine passing by an abnormal channel.*
5. *Incontinence and overflow of urine in the adult.*
6. *Incontinence of urine in the child.*

1. *Irritability of the bladder.*—This term is never to be employed as defining any morbid condition of the bladder, since it is too vague to denote anything else than a symptom, of which the practitioner has to discover the cause. It is commonly used in widely differing senses, and conveys therefore no definite meaning to the hearer. As denoting a symptom, it may be held to imply the simple fact of unduly frequent micturition, and should never be used, either in writing or otherwise, in any other sense. Whenever, therefore, this phenomenon is present, instead of regarding it as due to 'irritability of the bladder' as so frequently happens, the problem to be solved is what is the cause of that irritability? In all maladies of the bladder, and in most that affect the kidney also, unnaturally frequent micturition is present. It may vary in degree, and exist alone as a single symptom; or it may, as is much more usually the case, be accompanied by other symptoms, which aid the diagnosis. Thus it is present in all the inflammatory conditions of the bladder, and whenever foreign bodies or tumours exist there. Also when the bladder is full, and either habitually does not empty itself, or when absolute retention is present, in either case the wants to pass water are frequent and pressing. It is often present in stricture of the urethra, and in inflammations of that passage; also in chronic pyelitis, simple or calculous, in chronic nephritis, in Bright's disease, and in diabetes, as a result of the increased quantity of urine. It is present likewise during hysterical states, and under emotional excitements in many persons of either sex; and whenever the watery ele-

*Drawings illustrating Common Objects seen with the Microscope in Medicine.*

ments of the urine are rapidly and abundantly secreted.

2. *Diminished size of stream.*—This may occur either with or without organic obstruction in the passage. It is always present, of course, in congenital narrowing of the prepuce or of the external meatus; in organic stricture of the urethra; and mostly in enlarged prostate. It may be occasioned by inflammation of the urethra and prostate; and by impaired power in the bladder to expel its contents, from partial paralysis, atony, or other cause. Occasionally the channel is narrowed by irregular actions of the surrounding muscles, and thus 'spasmodic stricture' (not a good term) is spoken of as producing a diminution of the stream.

3. *Retention of urine.*—Retention of urine, partial or complete, is not to be confounded with 'suppression,' the latter being of course defective action of the secreting organ, so that no urine is produced, and the bladder remains empty. Retention is the product in almost all cases of mechanical obstruction, such as enlarged prostate from hypertrophy, tumour, or inflammation, or stricture of the urethra. Impacted calculus is sometimes the cause; sometimes also, but most rarely, the spasmodic action referred to above.

Treatment.—As the cause is a purely mechanical one in the great majority of instances, the remedy which should be applied is also a mechanical one, namely, a catheter of appropriate size and kind. The instrument, however, is not always at hand, and medicinal agents are valuable until it can be obtained. At the head of these no doubt is opium, which allays involuntary straining, and sometimes thus enables the patient to relieve himself by the natural method, at all events to some extent. It should be given in full doses, for the purpose either of relieving the patient's suffering and anxiety, or of acting favourably on the function; and the error in practice which has been most common is to give doses of 10 to 15 minims of laudanum or liquor opii, when 30 to 40 or more were necessary, and would have been highly useful. Of course the form of opiate may be varied, according to the habits of the patient or the views of the attendant. Simple opium is merely mentioned here as the type. Local bathing, as hot as it can be borne, is also a valuable adjunct. Diuretics, often given, are for the most part injurious; that is to say, when the cause is a mechanical one; the same must be said, in such circumstances, of the tincture of the perchloride of iron, once in some repute in retention of urine. As a general principle also, it is not to be forgotten that purgation commonly promotes the expulsive action of the bladder, often materially so, and tends to afford relief.

4. *Urine passing by abnormal passages.*—The urine may escape by abnormal channels, such as fistulæ. This condition is necessarily named as one of the 'disorders of micturition,' but its nature and treatment bring it solely under the hands of the surgeon.

5. *Incontinence and overflow of urine in the adult.*—The conditions so denoted are among those disorders of micturition which it is most important to understand. Nothing is commoner than to find a man, probably in advanced years, passing urine with increased frequency, even sometimes passing it without his will or knowledge, during sleep; and it is unfortunately not uncommon also, that he is told that this is a common weakness among elderly men, inseparable from the fact of age, and either not amenable to treatment, or not worthy of serious notice. Many a life has been endangered most certainly, and some even lost by such counsel. This condition is often loosely spoken of as 'incontinence' of urine; of which, however, it is not only not an example, but on the contrary indicates a condition of a precisely opposite character. The confounding of these opposite states is a matter of extreme importance. What does produce frequent micturition and so-called incontinence, is a bladder unable to empty itself, consequently always partially if not completely filled, from which the surplus must be either frequently discharged, or runs off 'incontinently.' The important point, then, is never to lose sight of the fact that frequent micturition, and above all urine involuntarily passed by elderly men, in nineteen cases out or twenty indicates retention (requiring the catheter), and not incontinence.

True incontinence, which means inability to retain, on the part of the bladder, is a very rare occurrence, and is present almost invariably only in cases of disease in the nervous centres producing paralysis in other parts of the body, as well as the bladder. When the bladder-symptoms alone are present, and no signs of paralysis elsewhere exist, it may be held as almost absolutely certain that the bladder itself is not paralysed. It may be over-distended with fluid from enlarged prostate; or its coats may be thinned and atonied, and so unable to contract on their contents; but there is no true paralysis of the bladder (commonly as that term is often employed) without central lesions of the kind above referred to, and affecting other functions also besides that of micturition.

Treatment.—In these partial retentions of urine, producing its overflow and involuntary discharge, the remedy is the catheter, and the case is mainly surgical. There are some instances in which restoration of the power of the bladder may be attempted by medicinal agents, such as strychnia, iron, and electricity, but their effect is little or none, apart from the habitual emptying of the organ by artificial means. In some cases perhaps they may be advantageously associated with the surgical treatment.

6. *Juvenile incontinence.*—A brief sketch of this common and well-known affection is all that our limits will admit. Nevertheless it is one relative to which much might be written, without exhausting a subject the pathology of which has wide and manifold relations.

In the earliest periods of childhood an undue frequency of passing water is often to be observed among individuals of both sexes, more commonly in boys than in girls. As age advances the infirmity usually lessens, and then disappears; whilst in exceptional instances it continues, without change, to puberty, and even for some years after that period has arrived. But the peculiarity of the case is that the urine is passed unconsciously during sleep, and this forms the

most serious symptom. In spite of all precautions a quantity of urine is discharged every night during deep sleep, an occurrence of which the child is quite unaware, and which as he advances in age he is wholly unable to control, however strong may be his disposition to do so. On the bladder becoming distended reflex action of the vesical muscular coats takes place, and the contents are discharged. The flow of urine is determined, as it would appear, not by inability on the part of the bladder to retain a small quantity of urine, but by its undue excitability or readiness to contract, so that the act of micturition can be exerted while the will is in abeyance through sleep. There appears to be something analogous between this condition and that which determines in after-life seminal emissions under similar circumstances. In a few instances, certain aberrations from a good standard of health seem to favour the production of these phenomena, especially sources of irritation in the rectum, which produce activity in that muscular apparatus, involving also the kindred muscles of the bladder, which are so closely associated. Thus the presence of ascarides or other foreign agents may suffice to occasion expulsive action in the bladder. During the period of infancy and early childhood the nervous system is highly impressionable, and the habit in question being accidentally set up, its persistence may result solely from repetition through the force of custom, long after the original cause has disappeared.

Sometimes slight malformations of the male organ favour the occurrence of incontinence; such as a narrow meatus, or a long prepuce which is never retracted, and is consequently in an unhealthy state.

Precocious development and extreme activity of the mental faculties, producing disturbed sleep, seem to favour the occurrence of incontinence. On the other hand, it is sometimes associated with a morbid deficiency of intelligence.

Treatment.—The treatment ordinarily necessary may be to some extent inferred, when examination of the patient has determined the presence or absence of the conditions named. This done, the next indication is to subdue the activity of the expulsive function of the bladder by some agent which possesses that power. The most powerful for this purpose is undoubtedly belladonna; one of the most notable qualities of this drug is its temporary influence to produce a paralysed condition of the vesical muscles. Thus, if administered to an adult whose powers of expelling urine are feeble, such, for example, as are commonly met with in advancing years, complete retention of urine is often produced. Of this the writer has seen many marked illustrations. Now, as has already been observed, in not a few of the cases of so-called 'juvenile incontinence,' its existence is due solely to persisting habit after the original occasion of it has long ceased; and these are certainly and rapidly cured by administering the agent in question. We have only to induce a partial paralysis of the bladder for a week or two, or for a few weeks at most, and by this means not only to destroy the old habit, but to develop a new one, namely, a habit of retention, and the annoyance disappears entirely and for ever. On meeting, therefore, with a case, whether in childhood or youth, the first indication is to correct any manifest deviation from the ordinary standard of general health; and secondly, to administer belladonna persistently. Small doses, suited to the age of the patient, suffice at first, and may be given every afternoon and evening only—say from eight to fifteen minims of the tincture on each occasion during the first week. In the second week of treatment, the dose may be augmented one half; and in the third week the original dose is doubled; meantime some improvement will almost certainly now be manifest. Since the ability to bear belladonna increases rapidly as the system becomes habituated to it, a large dose may be given during another term of three successive weeks, by which time the involuntary discharge of urine probably ceases. After this the dose may be gradually diminished, and at a rate more rapid than it was augmented: the habit of retention has probably been formed by this time, and when cessation from medicine takes place, no recurrence of the symptoms will be observed. Such is the writer's experience in a considerable proportion of the cases which have fallen in his way. But it must be confessed that a troublesome minority is met with in which the belladonna has had little or no useful influence. It generally exerts some, however, and it is worth while to be careful that the drug has been well prepared. Thus the writer has been successful with the belladonna of one chemist, after failure with that of another. Now, in regard of these obstinate and exceptional cases, what remains to be done? It may be assumed that an exhaustive observation has been made of all the functions, especially of those which perform digestion, and that it is unnecessary to insist further on this score, or to suggest the numerous details which such consideration gives rise to. All this done, there still remain modes of treatment of a local character, which ultimately almost always prove successful in these cases. These do not include blisters on the sacrum; apparatus to prevent the patient lying on his back, when asleep; arrangements to arouse him during the night once or twice to pass water voluntarily, and such measures—all of which are palliative means, and do little towards a radical cure, and which constituted the chief agencies employed some years ago.

Superior to all these in the writer's hands has been the application of a solution of nitrate of silver to the urethra, whether in the male or female. Even the use of a flexible bougie, small of course for children, passed daily, and removed in the course of a minute or so, is sometimes successful. But if this fails, the injection by means of a sufficiently long tube of the solution named to the prostatic portion of the urethra and neck of the bladder, is a remedy of no mean value. For young women up to the age of eighteen or twenty in whom this unfortunate infirmity still exists, the writer has found it almost, if not invariably, successful. It should be applied immediately after the bladder is emptied, in quantity, say, of a drachm, and of a minimum strength of ten grains to the ounce, up to treble that strength if necessary for subsequent appli-

cations. Enough should be employed to produce decided smarting, which shall continue for a day or two. A week or two should be permitted to elapse between each application.

It would not be right to omit the mention of other remedies besides belladonna, which may be used either alone or in combination with it. Such are the tincture of the perchloride of iron; strychnia; tincture of cantharides; and bromide of potassium. The latter, given at night only, has sometimes a manifestly beneficial effect.

HENRY THOMPSON.

**MIGRAINE.**—A synonym for megrim. *See* MEGRIM.

**MIGRATION OF CORPUSCLES.**—The escape of blood-corpuscles through the walls of minute vessels, and their passage into the surrounding tissues. The process is chiefly seen in inflammation. *See* INFLAMMATION.

**MILIARIA** (*milium*, a grain).—SYNON.: *Sudatoria* (*sudamina*); Fr. *Miliaire*; Ger. *Friesel.*

DEFINITION.—A vesicular eruption of the skin, generally associated with profuse sweating, and sometimes with pyrexia.

DESCRIPTION.—The proximate cause of miliaria is reduction of the vitality of the skin, under the influence of extreme heat and sweating. The vesicles have the bulk of millet-seeds; are developed close to the pores of the skin; are generally discrete; and are dispersed irregularly over the surface. They are thin, and contain at first a pellucid serum, which by magnifying the hyperæmic base on which they are developed, gives them a red appearance—*miliaria rubra*; in a more advanced stage the serum becomes milky and opaque, and then the eruption is called *miliaria alba.* When left to themselves the vesicles subside and dry up into an extremely thin scale.

TREATMENT.—The treatment of miliaria consists in subduing whatever feverish symptoms may be present; in lightening the clothing and coverings; in the use of tepid baths and tepid sponging; and after the bath, dusting the skin with some absorbent powder, such as fuller's earth. Sponging with lime-water is also useful; and the use of a lotion in which oxide of zinc is suspended in lime-water, in the proportion of two scruples to an ounce. This should be painted on the affected parts of the skin, and allowed to dessicate thereon.

ERASMUS WILSON.

**MILIARY ANEURISMS.**—Minute dilatations in connection with the small blood-vessels; especially met with in the brain. *See* BRAIN, VESSELS OF, Diseases of.

**MILIARY FEVER.**—A febrile condition attended with the eruption of miliaria. *See* MILIARIA.

**MILIARY TUBERCLES.**—True tubercles, which appear in the form of minute granulations. *See* TUBERCLE.

**MILIUM** (Latin).—A term suggestive of small size and roundness, resembling a millet-seed; a synonym of grutum. *See* GRUTUM.

**MILK FEVER.**—SYNON.: Ephemeral Fever; Fr. *Fièvre laiteuse*; Ger. *Milchfieber.*

DEFINITION.—A certain amount of constitutional disturbance, accompanying the flow of milk to the breasts, on the second or third day following delivery.

ÆTIOLOGY.—This condition appears to affect chiefly those who are in a feeble state, from want of nourishment, loss of blood, or other cause; or to occur when the child has not been put to the breasts sufficiently early to free the milk-tubes.

SYMPTOMS.—The symptoms of milk-fever are sometimes slight, and pass off very quickly, in which case the term 'ephemeral' is appropriate; but not infrequently the fever runs high, the temperature reaching beyond 102° Fahr., and the pulse beating 140 in the minute, from which state recovery is less rapid. The patient is generally seized suddenly with severe rigors; her teeth chatter, there is a sensation of cold water running down her spine, and she calls for blankets and hot-water bottles. At this time the breasts are swollen and sensitive. This chill soon gives way to a hot stage, which may last from two to twelve hours; the head aches fearfully; there is pain in the limbs, restlessness, a dry tongue, thirst, and sometimes delirium. The breasts now become hard and knotty, and very painful when touched. Then follows the sweating stage, from which great relief is experienced; as a rule the breasts become softer, and milk commences to flow from the nipples; the temperature falls; and all the symptoms abate. Sometimes, however, the breasts remain hard, and an abscess forms in one of them, in which case the temperature still remains high, though the other feverish symptoms subside.

TREATMENT.—During the cold stage the desire of the patient for hot-water bottles and blankets should be gratified; and care should be taken not to diminish the amount of clothing too rapidly during the hot stage. The bowels should be evacuated. A diaphoretic mixture should be administered; and the child should be put to the breasts as soon as the sweating stage sets in.

CLEMENT GODSON.

**MILPHOSIS** (*μίλφωσις*, falling off of the hair).—SYNON.: *Milkosis.*—Falling off of hair, especially of the eyebrows; an obsolete term.

**MIMOSIS** (*μιμέομαι*, I imitate).—A term applied to the phenomena of a disease, which resemble or imitate those of another disease.

**MIND, Disorders of.** *See* IDIOCY; and INSANITY.

**MINERAL WATERS.** — DEFINITION. — Mineral waters is the name given to those waters which, on account of the different saline or gaseous substances which they hold in solution, or of their elevated temperature, are used in the treatment of disease, either internally or in the various forms of baths.

The science that treats of the effects of mineral waters and baths on a great number of chronic maladies is called *balneotherapeutics.* In a wider sense this branch of medicine comprises also the use of sea-baths and of common water, but these subjects are treated in separate articles. *See* HYDROTHERAPEUTICS; and SEA AIR.

Courses of mineral waters and baths are to be regarded as methods of treatment analogous to courses of other remedies, but they are much more complicated, not only because many of the mineral waters are in themselves compound remedies, containing several active substances in combination, but also because in most courses of waters or baths the invalid is influenced by several other powerful agents, such as travelling, change of social conditions, of occupation, scene, and diet, change of climate, and increased exercise. Each of these influences has in itself a powerful action, and to their combination we must often ascribe a great part of the curative effects of balneotherapeutic courses; they ought therefore to be carefully considered in every individual case as part of the plan prescribed. We are unable in this article fully to discuss these important concomitant influences, but may refer for their critical estimation to Dr. Braun's treatise *On the curative effects of Baths and Waters* (Smith, Elder, and Co. 1875), and other works.

As most chronic diseases are treated by other remedies as well as by balneotherapeutic courses, the physician must in every case consider whether and when mineral waters are to be used, either instead of other remedies, or in combination, or in alternation with them.

General Composition and Classification.—The principal constituents of mineral waters are:—water, soda, magnesia, lime, and iron; combined with hydrochloric, sulphuric, carbonic and hydro-sulphuric acids, the two latter existing also in some waters 'free,' that is, uncombined with bases. Nitrogen and oxygen are likewise present in most mineral waters in various proportions; and in some there are also silica, arsenic, bromine, iodine, lithia, manganese, potash, organic matters, and several other substances in small quantities.

The substances dissolved in mineral waters are derived from the surface soil and the rocky strata through which the water deposited from the atmosphere passes. The dissolving power of this water is much increased by the gases which it absorbs, especially carbonic acid and oxygen. The constitution of mineral waters, therefore, varies according to the nature of the strata through which they have passed.

The different mineral waters may be grouped in various ways, as, for instance, according to their chemical constituents, their temperature, their geological origin or geographical distribution, or their physiological or therapeutical actions.

The *chemical* classification, imperfect though it is, offers the advantage, that it directs the attention at once to the most important constituents of the water. Some of the classes, however, are not named according to the substances contained in them in the *largest quantity*, but according to those considered most *potent*; such as the iron and sulphur waters. Another difficulty in the classification is, that some mineral waters contain several active substances in sufficiently large proportions to allow of their being placed in different classes; and, again, that some springs are so deficient in active principles as to render it doubtful where to place them. Of these latter, some appear to owe their virtues to the water alone, and its temperature, aided by the climate in which they are situated. Beginning with the latter as the most simple, we may group the mineral waters in the following principal classes:—

I. Simple thermal waters.
II. Common salt or muriated saline waters.
III. Alkaline waters.
IV. Sulphated saline waters.
V. Iron or chalybeate waters.
VI. Sulphur waters.
VII. Earthy and calcareous waters.

Some of the waters are chiefly used for bathing, others more for drinking, the majority for both purposes. In the consideration of the uses of the different spas, it is important to distinguish between the effects produced by the baths, and those caused by the internal use of the waters; and in larger works the plan followed by Dr. Braun, namely, to devote one section to 'bathing' and another to 'drinking courses of mineral waters,' offers advantages to the student; but in an article like the present it would be inconvenient, as frequent repetitions would be necessary.

The term 'baths' comprises not only the ordinary tub bath, but also swimming baths, or piscines; partial baths for the feet, the hands, and other parts; douches of great variety; vapour baths; and mineral mud baths. At many places also inhalations of vapour and pulverised spray form part of the treatment.

We will now give a short account of the different classes.

I. **Simple thermal waters.**—The simple thermal waters are characterised by poverty in solid and gaseous substances, and hence low specific gravity; by perfect transparency; by great softness; and by elevated temperature—varying in the different spas from about 80° to over 150° Fahr. Some of them contain nitrogen in larger proportions than the gases of waters usually do, others oxygen. They are often called *indifferent* waters, on account of the absence of special mineralization; and also *wild baths* (*Wildbäder*), on account of their being usually situated in wild mountainous regions.

Action.—The water of this class of spas when taken internally probably acts only as ordinary very pure warm water. By the drinking of warm as well as of cold water, the stomach is washed out; the secretion of bile, saliva, pancreatic juice, urine, etc. is increased; the tissue-change is augmented, and the removal of effete matters from the tissues and blood promoted; and by the acceleration of the retrogressive tissue-change, the progressive tissue-change becomes facilitated. As differences between warm water and cold water, we may mention that the latter acts more as a local excitant on the stomach, while the former is more easily absorbed, and makes less demands on the powers of the constitution, by not causing any expenditure of heat.

The simple thermal waters are much more used for *bathing* than for drinking courses; and the baths, as such, have probably the effects of ordinary warm baths, varying according to the

temperature of the baths, and the time spent in them.

As the *fundamental effects of warm baths*, which effects form part of the action of all kinds of warm baths, simple as well as mineralised, we may regard:—

(1.) That they soften and purify the skin more rapidly than cold baths, and prepare it for perspiration.

(2.) That they equalise and diminish the loss of heat, and, according to the temperature of the bath, lessen and prevent it altogether; and that in the hot bath, heat is even added to the body.

(3.) That the circulation in the skin is accelerated.

(4.) That the organic functions and the tissue-change are slightly stimulated, or rather facilitated, without any strong reaction on the part of the organism.

(5.) That the nervous system and muscular irritability are calmed.

(6.) That the absorption of exudations is promoted.

These effects, as already mentioned, vary considerably with the degree of heat. In the *tepid bath* (from 80° to 95° Fahr.) the central nervous system and the action of the heart are but slightly influenced; in the *warm* bath (from 96° to 102° or 103°) the heart's action is quickened, but the respiration is generally but slightly affected; in the *hot bath* (from 103° to 110° F.) the central nervous system becomes much more excited; not only is the heart's action further accelerated, but the respiration becomes rapid, and sometimes irregular; and the hyperæmia of the skin leads to perspiration on removal from the bath.

Baths of a temperature above 110° are scarcely ever used, and only for a very few minutes. The effects vary also considerably, according to the duration of the immersion.

Uses.—The *drinking courses* of these waters may assist in the treatment of irritable forms of affections of the throat, stomach, and intestines, with spasmodic cough, cardialgia, constipation from sluggish secretion of bile and intestinal juices; and by increasing the tissue-change, they are useful in chronic rheumatism and gout.

One of the main uses of the simple thermal baths is to allay over-excitability and hypersensibility of the nervous system in its various spheres; thus they often act beneficially in cases of neuralgia, hyperæsthesia, painful menstruation, and hysterical tendency. Their reputation in painful wounds and cicatrices is historical. In these cases, as well as in chronic rheumatism in its various forms, and sciatica, the hotter are more useful than the tepid baths. In some forms of paralysis and loss of muscular power depending on peripheral changes, such as exudations on nerve-sheaths, good effects are produced; but if they are caused by changes in the centres of the nervous system, not much is to be expected. In gout the internal use of other mineral waters is generally required, but as second courses the simple thermal waters are often useful; and in many delicate gouty persons the balneotherapeutic treatment ought to be restricted to courses of tepid baths, aided by climate and diet. Most of these conditions can be also treated with other waters.

Enumeration, and Selection.—The choice of a simple thermal spa is to be guided, not by the name of the disease alone, but also by the state of constitution, and many concomitant circumstances. The simple thermal waters deserve, *cæteris paribus*, the preference, when gentle management is required—when it is desirable to make as slight demands as possible on the powers of the constitution. Their action is in this respect greatly assisted by the mountainous climate enjoyed by the majority of these baths. The selection of a special spa in a given case depends on the nature of the case in the widest sense; on the degree of elevation which is desirable; on the means of treatment obtainable and customary at the different spas, including the most important agent—the spa physician; on the accommodation, the food, manner of living, and social conditions; on the distance and means of reaching the spa; and on many other circumstances. Information on these subjects can only be obtained by the study of larger works (*see* the English edition of Braun's Work on Baths, pp. 123 to 192), and by personal visits. We can give here only the names of the principal spas of this class arranged according to their elevation:—

| Name. | Country. | Elevation (approximative). Feet. | Temperature of springs Fahrenheit. |
|---|---|---|---|
| Panticosa | Spain (Pyrenees) | 5000 | 77°–92° |
| Leukerbad (Loeche les Bains) | Switzerland | 4600 | 102°–122° |
| Bormio | Italy | 4300 | 90°–104° |
| Gastein | Austrian Alps | 3300 | 95°–114·8° |
| Pfäffers | Switzerland | 2115 | 100·4° |
| Johannisbad | Bohemia | 2000 | 86° |
| Bagnères de Bigorre | France (Pyrenees) | 1850 | 90°–95° |
| Ragatz | Switzerland | 1570 | 96° |
| Badenweiler | Baden | 1425 | 86°–90·5° |
| Landeck | Silesia (Prussia) | 1400 | 66°–84·2° |
| Wildbad | Wurtemberg | 1323 | 95°–98·6° |
| Plombières | France | 1310 | 66°–156° |
| Luxeuil | France | 1300 | 65°–163° |
| Neuhaus | Styria (Austria) | 1200 | 95° |
| Liebenzell | Wurtemberg | 1113 | 72°–82° |
| Warmbrunn | Silesia (Prussia | 1100 | 96·8°–104° |
| Buxton | England | 1000 (nearly) | 82° |
| Schlangenbad | Nassau (Prussia) | 900 | 81·5°–86° |
| Néris | France | 800 | 114°–125° |
| Römerbad and Tüffer | Styria (Austria) | 700–800 | 93°–100° |
| Teplitz | Bohemia | 650 | 95°–120° |
| Lucca | Italy | 500 | 100°–129° |
| Bath | England | 100 | 100°–120° |

Many other slightly mineralised warm waters, whose principal action is to be referred to water and heat, might be mentioned here, while several of the places contained in the list, as Leukerbad, Bormio, Bagnères de Bigorre, and Bath, might find places in other divisions.

The very hot Algerian baths, Hammam-Meskoutin, Biskra, and Hammam R'Irha, the last beautifully situated some sixty miles from Algiers, belong likewise to this class.

Allied in their action, though more powerful in their demands on the system, and in their effects, are the natural hot vapour baths in the large cave of Monsummano in Upper Italy, and in the smaller excavation in the rocks of Battaglia in the Euganean mountains.

II. **Common salt or muriated saline waters.**—Composition.—Common salt or chloride of sodium is the principal solid constituent of the waters of this class; but this substance is contained also in many other mineral waters, especially in some alkaline, in some sulphur, and some Glauber's salt waters, and has a considerable share in the effects of these waters.

Action.—In order to appreciate the action of the common salt waters, we must bear in mind that common salt forms part of all the tissues and juices of the body; that it acts as a solvent in the stomach, promoting digestion; that it is essential to the formation as well as the disintegration of cells and tissues; that it stimulates not only the retrogressive, but also the progressive tissue-change or nutrition of the body; and that it is a great agent in the endosmotic qualities of the blood and in the processes of secretion and absorption. Chloride of sodium stimulates the secreting apparatus of the stomach and intestines, and hence the action of the bowels, and the circulation of the portal system, and indirectly the general circulation. It quickens the tissue-change, and through this, as well as the increased circulation, promotes absorption of pathological products, without lowering the organism. In larger doses, however, beyond about five drachms per diem, irritation of the mucous membrane of the stomach and intestines may be produced. The action of the common salt waters is modified by their accompanying properties, especially by the carbonic acid contained in them, by their temperature, and by the degree of their concentration.

The *carbonic acid* in this and other classes of waters quiets the sensitive nerves of the stomach; stimulates the secretion and peristaltic action of the stomach and bowels; and indirectly increases the secretion of the kidneys. In large quantities, however, if not rapidly ejected by eructation, it may produce, by being absorbed, poisonous effects on the blood and nervous system. The presence of carbonic acid in salt waters increases the effects of chloride of sodium on the stomach and intestines, and by accelerating the passage of the waters from the stomach into the intestinal canal, promotes the action of the bowels.

*Elevation of the temperature* of the water produces more rapid absorption, and thus diminishes the local, and increases the more distant and constitutional effects.

*Concentration* increases the local stimulation.

As to the action of these waters in the form of *baths*, the chloride of sodium and other chlorides (though any absorption through the skin of these and other salts contained in mineral waters is doubtful or, at all events, forms only a small part of their therapeutic effects) stimulate the cutaneous ends of the nerves and the capillaries, and promote through this the nutrition and tone of the skin, and indirectly the tissue-change, an action which is heightened by the presence of carbonic acid, as witnessed at the gaseous saline baths of Rehme and Nauheim.

Uses.—Salt waters and salt baths are useful in weakness of the skin; in tendency to rheumatic fever or bronchitis; in retarded convalescence from acute and chronic illness; in enlargements of joints from preceding inflammation; in scrofulous complaints; in many forms of anæmia and chlorosis—especially those where iron alone is not borne; in numerous cases of Indian cachexia; and in cases of sluggish circulation in the portal system, which leads to innumerable varieties of digestive troubles, to congestion of the liver, and of the pelvic organs in women, and to piles.

Enumeration, and Selection.—The same classes of cases, as far as the name goes, are treated also by alkaline and sulphated waters. The individual conditions must guide the practitioner in deciding for either the one or the other kind of waters, and for the special spa, according to the strength of the springs, the amount of carbonic acid, and concomitant conditions. Spare and pale persons, we may mention, mostly bear the common salt waters better than strongly alkaline and sulphated waters. Common salt waters are to be found in almost all countries; we can only give the most important or best known. In *England*:—Droitwich—perhaps the strongest of all brines, with good arrangements—Nantwich, Middlewich, Woodhall, and Harrogate; Leamington and Cheltenham contain likewise much common salt, in addition to sulphate of soda. In *Germany*:—Kissingen, Homburg, Rehme-Oeynhausen, Nauheim, Kreuznach, Soden, Pyrmont (which contains salt as well as iron springs), Wiesbaden, Hall in Austria, Hall in the Tyrol, Hall in Wurtemberg, Reichenhall, Ischl, Kreuth, Dürkheim, Salzungen, Canstatt, Cronthal, Baden-Baden, and several others. In *France*:—Bourbonne-les-Bains, Lamotte-les-Bains, Balaruc, Salins. In *Italy*:—Ischia, Castellamare, Monte Cattini, La Porretta. In *Switzerland*:—Bex.

III. **Alkaline Waters.**—Composition.—The alkaline waters contain *carbonate of soda* as a prominent constituent; they are also more or less rich in *carbonic acid*; and some are distinguished by so large a proportion of *chloride of sodium* as to warrant a sub-division into—(1) *simple alkaline waters*; and (2) *muriated alkaline waters*.

Action.—In considering the dietetic and medicinal value of these waters, we must bear in mind that soda in combination with carbonic acid is a most important constituent of the human body. Oxidation and tissue-change seem to be greatly influenced by the presence of soda; various proteinaceous bodies seem to be kept in solution by it; it has a considerable share in the secretion of saliva and bile, and in the digestive processes; and, according to Liebig, it acts as a vehicle for the carbonic acid from the blood to the lungs.

Carbonate of soda may be considered as an antacid, as a diuretic, as a promoter of tissue-change, and as a solvent. The beneficial effects of alkalis are in general produced only by a systematic use of *small* doses; whilst *large* quantities cause, by their excessive solvent effect, emaciation, and, by their depressing influence on the heart's action, diminish the tissue-change. The action of soda differs in this respect from that of chloride of sodium, which even in considerable doses increases the tissue-change, and does not so easily exercise an emaciating effect.

Uses.—The conditions in which alkaline waters are mostly employed are certain forms of dyspepsia, with undue acidity of the stomach; congestive conditions of the liver from sluggish portal circulation; tendency to gallstones; diabetes; uric acid diathesis, and its results—gravel and lithiasis; some forms of gout; and especially chronic catarrhal affections of the mucous membranes of the respiratory, digestive, and genital organs.

Enumeration, and Selection.—Where it is necessary to improve the state of the blood, or to avoid emaciation, the muriated alkaline are preferable to the simple alkaline waters.

1. The principal spas with *simple alkaline waters* are:—*a. Hot*:—Vichy, Neuenahr, Mont Dore, Chaudes Aigues, and Neris, the three last being feebly mineralised; *b. Cold*:—Apollinaris, Vals, Salzbrunn, le Boulou, Evian, Bilin, Fachingen, Geilnau, Wilhelmsquelle, Taunus, Giesshübel, Soulzmatt, and Marcolo.

2. The chief *muriated alkaline waters* are—(*a*) Ems, Royat, and La Bourboule, which represent the *hot* springs; whilst (*b*) Luhatschowitz, Selters, Gleichenberg, Roisdorf, Rosbach, Vic-sur-Cère, and Toennistein are *cold*.

We ought to remark that several of the waters in this class, especially la Bourboule and Mont Dore, contain *arsenic* in appreciable quantities.

IV. **Sulphated waters.**—Composition.—We include under this term those springs which are characterised by a preponderating amount of the sulphates of soda or magnesia, or both sulphates together. They may be subdivided into (1) *simple sulphated waters* or *bitter waters*; and (2) *alkaline sulphated waters*, which latter contain also carbonate of soda and chloride of sodium.

Action.—The *bitter salts* can scarcely be said to be constituents of the organism; they seem to act by stimulating, and in larger doses irritating the mucous membrane of the stomach and alimentary canal, causing thin watery secretion, and in large doses diarrhœa. Sulphate of soda is less irritating than sulphate of magnesia. The peristaltic action of the bowels is likewise increased by them. Their continued employment is apt to cause emaciation. By the presence of carbonate of soda and chloride of sodium, the action of the bitter salts is modified.

Uses.—The bitter waters are useful in habits of constipation with sluggish portal circulation, in hæmorrhoidal tendencies, in congestion and enlargement of the liver and spleen, in some forms of dyspepsia, in gallstones and allied affections, in gouty conditions, lithiasis, and diabetes; and, *cæteris paribus*, have in stout and in so-called plethoric persons, the preference over the muriated saline waters.

Enumeration, and Selection.—Where prolonged courses are required the weaker sulphated waters, and especially the alkaline sulphated waters, are to be preferred; whilst the stronger bitter waters, are more frequently selected for occasional purging doses. 1. The principal *simple sulphated* or *bitter waters* are:—Galthof, Pullna, Saidschutz, Sedlitz, Birmensdorf, Ivanda, Hunyadi Jànos and other springs near Ofen, Epsom, Aranjuez, Friedrichshall, and Mergentheim, the two latter being also rich in chlorides. Weaker springs of a similar nature are at Leamington and Cheltenham—both with a large amount of common salt, at Scarborough, and at the Purton Spa. 2. The principal *alkaline sulphated waters* are Carlsbad, Marienbad, Tarasp-Schuls, Franzensbad, Elster, and Bertrich. The constitution and the action of the waters of Carlsbad and Bertrich are modified by their thermal nature.

V. **Iron or chalybeate waters.**—Composition.—Iron is contained in the majority of mineral waters; but we regard as iron waters only those where the quantity of iron is, in proportion to the other constituents, so far predominant as to give a therapeutic character to the springs.

Action.—The formation of blood-globules, the contractility of the blood-vessels, the oxidation and the production of heat, and the general nutrition of tissues seem to be favoured by the use of iron waters. A small quantity only of iron seems to be absorbed by the stomach, none through the skin; the action of chalybeate baths seemingly being due to the influence of the water and carbonic acid only.

Uses.—The conditions most benefited by chalybeate waters are the various forms of anæmia, or poverty of blood and particularly of red corpuscles, especially when caused by actual loss of blood, suppuration, or previous acute or chronic disease. The liver and digestive organs, however, must be in healthy working order, whilst in cases of anæmia accompanied by congestion of the liver and spleen, chalybeates alone are rarely useful, but must be preceded or modified in their action by the use of saline waters; and this is often the case not only in anæmia of Indian and malarious cachexia, but also in chlorosis. Neuralgia, sterility and impotency, and general debility are often benefited through improvement of the general health. Those iron waters are most useful which contain the iron in the form of the bicarbonate of the protoxide, kept in solution by free carbonic acid.

Enumeration, and Selection.—Iron springs are (1) *comparatively pure*, that is containing only a few grains of other substances in 16 ounces of water:—Schwalbach, Spa, Brückenau, Schandau, Liebwerda, Flinsberg, Freienwalde, Recoaro, Koenigswarth, Liebenstein, Altwasser, Alexisbad, Muskau, Tunbridge Wells, and one spring at Harrogate: (2) *compound iron springs*, that is, which contain, in addition to iron and carbonic acid, a moderate quantity of other salts, especially the carbonates of soda, lime, and magnesia, the sulphates of soda, magnesia, and lime, and common salt:—Aratapak, Orezza, Pyrmont, Driburg, Rippoldsau, Griesbach, Antogast, Petersthal, Bocklet, St. Moritz, Reinerz, Godesberg, Cudowa, Imnau, and Santa Catarina.

VI. **Sulphur waters.** — Composition. — Amongst sulphur waters we class those springs which contain either sulphuret of hydrogen, or the sulphuret of sodium, calcium, potassium, or magnesium, in an appreciable and constant proportion. They are partly thermal, partly cold; and some of them, especially Aix-la-Chapelle, Uriage, and Baden in Switzerland, contain a considerable proportion of common salt and other solids, which are to be taken into consideration in the appreciation of their effects.

Action.—It is difficult to describe the physiological effects of the sulphur waters, as far as they depend on such minute quantities of sulphur as are contained in them. Sulphur water baths seem to act in the same manner as simple baths. If the waters are taken internally, some sulphuretted hydrogen is probably absorbed, entering the circulation through the portal vein. The pure sulphur waters exercise a constipating rather than an aperient effect. The fæces become mostly blackened from sulphuret of iron. The protracted use of these waters is apt to lead to a certain degree of anæmia, possibly from the action of the sulphur on the iron of the blood-globules.

Uses.—Sulphur waters are mostly used in combined bathing and drinking courses, as also by inhalation, in cases of metallic poisoning; in congestion of the liver; piles; bronchial, laryngeal and pharyngeal catarrh; in early chronic phthisis; in numerous cutaneous affections, especially the herpetic dyscrasia of the French; in rheumatism and gout; and in constitutional syphilis.

Enumeration, and Selection. — The best known *thermal sulphur waters* are: — Eaux Bonnes, Eaux Chaudes, Cauterets, Saint Sauveur, Barèges, Bagnères de Luchon, Ax, Escaldes, Le Vernet, Amélie-les-Bains, Uriage, Allevard, Aix-les-Bains, Aix-la-Chapelle, Baden in Austria, Baden in Switzerland, Lavey, Schinznach, Battaglia and Abano in the Euganean Mountains; Panticosa; Mehadia, and other springs in Hungary; and Helouan or Helwan, near Cairo. *Cold sulphur springs* are:—Eilsen, Nenndorf, Langenbrücken, Weilbach, Meinberg, Reutlingen, Enghien, Challes, Stachelberg, Heustrich, Gurnigel, some Harrogate springs, Llandrindod and Builth in Wales, Moffat and Strathpeffer in Scotland, and Lisdunvarna in Ireland.

VII. **Earthy and calcareous waters.**—Composition.—As *earthy* and *calcareous waters* we designate those springs in which the earthy substances, especially carbonate and sulphate of lime and carbonate of magnesia, form the prominent constituents.

Action.—In the shape of baths, the earthy waters act almost in the same way as ordinary water baths. Internally taken, the carbonate of lime exercises an antacid and a soothing effect on the mucous membrane of the stomach and intestines, and together with the sulphate of lime is slightly astringent and constipating. If lime is absorbed, it may possibly assist in the formation of cells and of bone, and may exercise also a soothing effect on other mucous membranes; this point, however, can scarcely be regarded as settled.

Uses.—These waters, according to their composition, are useful in digestive troubles with tendency to acidity, diarrhœa, and undue irritability of the mucous membrane. They are employed also in osteomalacia, rhachitis, and tuberculosis; and further, in some skin-diseases, especially in eczema and psoriasis, where, however, the long continuation of the warm bath, that is the soaking of the skin, is of more importance than the nature of the solid constituents contained in the water. Some of these waters possess a great reputation in chronic catarrh of the bladder, and in tendency to gravel and stone; but probably the large quantity of water consumed, as for instance, at Contrexeville, and the consequent dilution of the urine and the washing out of renal tubules, are here to be regarded as the principal causes of the useful effect. The best known earthy or calcareous waters are:—Wildungen, Lippspringe, with the Inselbad, Weissenburg, Contrexeville, Bagnère-de-Bigorre, St. Arnaud, and Cransac; and amongst the table waters:—Couzan, St. Galmier, and the Taunus water.

Many of the waters mentioned in other classes might also be mentioned here, such as Bormio, Leuk, Bath, and Lucca, named under the simple thermal waters; and Baden in Austria, Baden in Switzerland, Schinznach, Battaglia, Abano, and others enumerated under the sulphur waters.

**On prescribing mineral waters and baths.** In every case we must first settle the question whether the treatment by mineral waters and baths offers advantages over ordinary treatment. If the question is answered in the affirmative, we have to consider not only the nature of the disease, but quite as much the nature of the individual in whom it occurs; the amount of vital forces in general; the power of reaction; the state of the different organs; and whether they can assist in relieving the diseased part of the organism, or whether they are unable to respond to any unusual demand made on them. Thus we shall be enabled to decide whether stronger therapeutic influences can be employed; whether longer and rougher journeys are permitted, and colder climates and seasons; or whether delicate treatment is essential, comprising the simple thermal baths, summer temperature, mountain climates of moderate elevation, and easy journeys. The baths and waters are not to be selected according to the chemical constitution of their springs alone, but the means and appliances in use, and the accustomed methods of treatment at certain places, the qualities of the local physician, the accommodation, the food, the cooking, and the social conditions, the facility of reaching a place, the climate and other elements of 'change,' are each and every one to be taken into consideration. It must be evident already from these remarks, that the same morbid affection can occasionally be treated with advantage by different classes of mineral waters and at different spas, and that apparently widely different diseases may be benefited by the same spa; not only because many mineral waters are composed of different active elements, but also because the internal and external administration of the same water may be so much varied as to produce a great variety of effects. In many instances the disease itself cannot be directly attacked, but our efforts must be directed towards improving the general constitution, and through this influencing the diseased portion of the organism.

We cannot do more here than give some hints regarding the groups of diseased conditions in which mineral waters may be prescribed.

1. *Anæmia.*—In cases of anæmia it is essential to consider whether the condition is caused, first, by direct loss of blood and its component parts; secondly, indirectly by acute or chronic disease.

sleeplessness, neuralgia, and inability to take up food; thirdly, by congestion of the pelvic organs, with loss of blood and albuminous juices; or, lastly, by lymphatic diseases, or visceral affections resulting from warm climates. The more the first cause preponderates, the more we may expect from the direct use of iron; and we have then to consider whether pharmaceutical preparations, or iron waters with or without change of climate, with or without baths, are to be preferred, or whether iron springs are to be recommended. In the indirect forms of anæmia the mildest thermal treatment, with mountainous climates of moderate elevation, or the latter alone, are often the only beneficial courses in delicate constitutions; whilst in others somewhat less feeble according to individual conditions, common salt waters and baths with or without iron, or the gaseous tepid salt baths of Nauheim and Rehme, or the much stronger influences of sea air and of sea baths, are useful. In the third group the common salt waters with a certain amount of iron, and occasionally the sulphated saline waters, must generally precede every other attempt at strengthening; for the acceleration of the portal circulation, the regular emptying of the different branches of the portal vein, and the increased tissue-change are essential to the improvement of the nutrition and sanguification; and only after such a preliminary course the purer iron waters and the higher alpine air are likely to become useful.

2. *Sluggish portal circulation.*—A sluggish condition of the portal system forms a frequent complication, not only of anæmia, but of a great many ailments of the different systems of the body; and is often only a part of a general want of tone in the organic muscular fibre, especially of the right ventricle and of the whole venous system. It is difficult to find a name for these, by no means, rare constitutional defects, which form the main characteristics of what the old German physicians called 'abdominal plethora.' If we only know what we mean by the terms, we may call these conditions *portal venosity* and *general venosity* according to the extent of the defect. They form the principal complications and in many cases the main cause of the most varied digestive troubles, as acidity, sickness, flatulency, constipation, and intestinal catarrh. They are also at the root of congestion of the hæmorrhoidal vessels and piles, of varicosity of the legs, of congestion of the womb and ovaries and menstrual anomalies, of congestion of the liver and imperfect secretion of bile, and of chronic bronchial catarrh, with dilatation and imperfect contraction of the right ventricle. Gravel and gout are likewise often associated with sluggish portal circulation. In the treatment of these very numerous complaints, widely different though they appear to be, we have therefore always to ask in how far they are complicated by portal venosity, and in how far diet, regimen, pharmaceutical and balneotherapeutic treatment directed against this venosity may relieve the special case before us. If this portal venosity occur in *lean* and *delicate* persons, the common salt-waters as Kissingen, Homburg, Soden, &c., which increase the tissue-change without impairing the nutrition, internally and in the form of baths, or the simple thermal baths in sub-alpine situations, assisted by the internal use of salt waters, are often useful. If the individual be *stout* and inclined to costiveness, the sulphated saline waters with soda and common salt, such as Carlsbad, Marienbad, Franzensbad, Elster, and Tarasp, are the most effective; while again in others of this class the simple alkaline waters, such as Vichy, are preferable. In all these cases, however, the treatment by waters and baths ought to be assisted by regulation of diet and exercise.

3. *Gravel.*—Gravel, especially uric acid gravel, is usually complicated with portal venosity, and is to be treated accordingly. As a symptomatic treatment, the alkaline mineral waters have a more lasting effect than the administration of pharmaceutical preparations; but more effective are alkaline waters containing sulphates, and especially the less concentrated and hot springs of Carlsbad. Most useful of all, especially for home treatment, are the waters of Luhatschowitz, with their peculiar combination of carbonates and chlorides.

4. *Gout.*—Gout is likewise often complicated with and aggravated by portal venosity, and we must always endeavour to facilitate the removal of the products of the retrogressive tissue-change; but gout occurs in the most widely different constitutions. If gout and its allied forms be met with in so-called strong constitutions, with a good primary digestion, ability to sustain a long morning fast, accompanied perhaps by a tendency to stoutness, and an acid urine of tolerably high specific gravity, becoming iridescent with nitric acid, the alkaline sulphated waters of Carlsbad, and sometimes those of Marienbad, Franzensbad, Elster, and Tarasp are most useful, though they cannot altogether remove the gouty disposition. If the time be short, and a long rest after the course not permitted, the simple alkaline waters of Vichy may be selected, and in more delicate constitutions the muriated alkaline waters of Royat, Ems, or Baden-Baden. In lean and decrepit gouty patients the common salt-waters of Homburg, Kissingen, Harrogate and Leamington, the arsenical salt-waters of La Bourboule, the waters of Wiesbaden, the muriated sulphur waters of Aix-la-Chapelle, or, again, weak muriated alkaline waters like Baden-Baden, deserve a trial. In many delicate persons the simple thermal waters of Buxton, Schlangenbad, Wildbad, Ragatz, Gastein, and Bath, and the sulphur waters of Aix-les-Bains and Bagnères-de-Luchon, offer great advantages; but numerous cases may be regarded as quite intractable by baths, waters, and medicines, and in these diet and climate are the only means of management.

5. *Chronic Rheumatism.*—In chronic rheumatism, associated with exudation round the joints, the hot thermal treatment, either at the hotter simple thermal spas, as Bath, Teplitz, the Euganean baths, or the natural vapour baths of the cave of Monsummano, at the weaker hot salt-waters of Wiesbaden and Baden-Baden, or at the thermal sulphur waters, such as Aix-la-Chapelle, Aix-les-Bains, Barèges, Bagnères-de-Luchon, Laux Chaudes, &c., are the most useful; or in more delicate cases, the gaseous thermal salt

waters of Rehme and Nauheim. In the muscular varieties, with stiffness, the hotter waters, assisted by douches and shampooing, are specially indicated. In many instances, however, the cause of constantly recurring rheumatism is weakness of the skin, and here the tonic forms of the cold water-cure and sea-baths promise more permanent good than hot baths.

It is impossible, in a short treatise, to enter into all the morbid conditions suitable for balneotherapeutic treatment; but the preceding remarks may show that the physician, in prescribing waters, ought to base his advice on the teachings of physiology, pathology, climatology, and general therapeutics, in the widest sense.

We might be expected to give a few hints on diet, during mineral-water courses, but no general rules can be laid down. Every individual requires rules for his own case, and rules which may be necessary during the use of muriatic saline, or sulphated saline waters, are not necessary in other courses—for instance, of simple thermal or of iron waters.

The bath physician ought to guide every invalid, according to his or her individual condition, as well with regard to diet, as to the internal or external use of waters, and with regard to exercise and other hygienic and therapeutic aids. The result of a course of waters often depends entirely on this guidance. It is important, therefore, to supply the bath physician with a statement as to the ailments and the constitution of the invalid.

Length of Treatment.—It is a general belief that three or four weeks is the term for a course of waters or baths; but it is impossible to fix a definite time. As courses of iodide of potassium, of iron, of quinine, or of mercury must be of different duration in different individuals, exactly so we find it with mineral waters; and as two or three courses of a remedy may have to be taken in the same year, so it is often desirable to give two or three courses of Vichy, of Carlsbad, or of Spa waters, in one year, though not all of them need be taken at the spring. In many cases preparatory courses are advisable, climatic, medicinal, and balneotherapeutic, and in as large a number secondary courses. Most invalids would do well not to return immediately after a course of baths to their usual abodes and accustomed ways of living. In many instances, however, it is imperatively necessary to abstain from work, and to keep to a simple diet for about a month or more after the course of waters, and this is especially the case with the more powerful waters like Carlsbad and Marienbad.

Season.—As to the period of the year, there is no time when the different waters might not be drunk, if it were necessary. Most spas are open only from May till October, some longer, some only from June till September; but some few localities are partially open also during winter, especially Aix-la-Chapelle, Aix-les-Bains, Baden-Baden, and Wiesbaden. Many waters can be taken at home, and at any time of the year; but the elements of change are wanting, and the strict adherence to regimen and diet is often difficult. During the summer months the demands on the human body are diminished, by the external warmth and the greater equability of the meteorological influences; nature is more exhilarating, and invites to outdoor life and exercise, without much risk of chills and their consequences; and delicate persons, therefore, ought to select the summer months for courses at the spas. The later parts of the spring and the autumn, however, offer advantages to the more robust, who at those times find the baths and the hotels less crowded, and who can then receive more attention from the bath physician. And, besides, those who are unable to bear heat have in the earlier and later parts of the season the benefit of cooler air, which is to the average visitor a real advantage at some of the hotter localities, like Aix-les-Bains, Aix-la-Chapelle, Ems, Creuznach, Soden, Baden-Baden, and Ragatz.

Hermann Weber.

**MISCARRIAGE.**—Synon.: Abortion; Fr. *Avortement*; *Fausse Couche*; Ger. *Fehlgeburt.*

Definition.—Miscarriage is the interruption of gestation before the fœtus has become viable.

Frequency.—The relative frequency of miscarriages, of premature labours (between the seventh and ninth months), and of full-time births, cannot be very closely estimated. Early abortions are often unnoticed or forgotten. The statement of Dr. Whitehead is very striking, that of sixty-four women who had lived in wedlock till the ménopause, there were only eight who had not at some time had a miscarriage. His statistics show that the period at which abortions most frequently occur is about the third month.

Ætiology.—The causes of abortion may be found either:—(1) on the part of the ovum or fœtus; or (2) on the part of the mother.

1. *Fœtal.*—The causes of miscarriage on the part of the ovum are:—(*a*) all the diseases of the fœtus itself which compromise its life, such as acute fevers and chronic diseases—chiefly of syphilitic origin; and (*b*) many of the morbid changes in the fœtal appendages. Of the latter the most noteworthy are, first, diseases of the chorion, the more familiar of which is the hydatidiform degeneration; secondly, abnormal conditions of the umbilical cord, such as excessive torsion with constriction of the vessels, convolutions of it simultaneously round the neck and lower extremities, and the formation of tight knots upon it; and thirdly, abnormal relations and morbid conditions of the placenta. Where the placental area, for example, is of too limited extent, the ovum easily becomes detached from the uterus; where it is too large, extravasations of blood easily take place in the lobules. When the placenta is planted low down in the cavity of the uterus, it is liable to partial detachments; and thus in a great many cases abortion takes place at an early stage in patients who would have been subject to the greater dangers of unavoidable hæmorrhage, had the pregnancy gone on towards the usual term. Again, the morbid processes which occur in the placenta, inflammatory, degenerative, or apoplectic, whether due to a syphilitic taint, or to other causes, lead to death of the embryo or fœtus, and thus in many instances to the early casting of the ovum. It is worth while to note that death of the embryo, and morbid changes in its appen-

dages, do not necessarily at once cause abortion. Three or four weeks usually elapse after the death of the fœtus ere its expulsion is effected; the decidual membrane having in the interval undergone retrogressive changes. It is only when such an extravasation of blood takes place as leads to sudden distension of the uterus, or when the membranes burst and such escape of liquor amnii occurs as leads to its sudden collapse, that the organ is stimulated to the immediate evacuation of its contents. Hence, while the ultimate cause of abortion is often enough traceable to the ovum, the immediate occasion is more frequently due to some maternal condition.

2. *Maternal.*—The causes of miscarriage on the part of the mother are either (*a*) *general*; or (*b*) *local*. (*a*) Amongst the *general* or constitutional conditions that favour the occurrence of abortion we note, first, all the causes that lead to depression of a woman's health. Abortions are frequent, for instance, in times of famine; amongst women who yield themselves to excesses; in anæmic women; and in those tainted with the syphilitic poison. Often enough, especially in the last class, the cause of the abortion can be traced to some morbid change in the maternal portion of the placenta; but sometimes it seems to be due simply to the impure or impoverished condition of the patient's blood. Secondly, fevers, such as the zymotic fevers, and acute inflammations, more particularly of important viscera, such as pneumonia, occurring in gravid women, very frequently become complicated by abortion. Thirdly, shock may bring on miscarriage, whether operating simply through the nervous system, of which we meet occasional examples; or, as is more frequently the case, by producing a more direct physical impression upon the uterus, as in cases where the patient leaps or steps suddenly down from a height, lifts a weight, stretches her arms above the head, or is exposed to any sudden jar or more protracted jolting. Though many cases of abortion are attributed to such a cause, it is always to be borne in mind that in some of these, at least, that supposed cause would not have led to the disaster unless there had already existed a predisposition in some morbid condition of the uterus or its contents.

Amongst (*b*) the *local* causes we find, first, and most frequently, diseased conditions of the deciduæ. Commonly in these cases the patient had previously been the subject of chronic endometritis; though occasionally cases are met with where there have been no marked symptoms previously, and the degenerative process may affect either the vera or reflexa or serotina, separately or simultaneously. Second in frequency under this head we have the abortions due to displacements of the uterus, these being commonly either descents or retroversions. Thirdly, neoplasms of the uterus, such as cancers or fibroid tumours, sometimes permit the occurrence of conception, but prevent gestation running to its natural term. Fourthly, the presence of tumours in the neighbouring organs, or inflammatory adhesions among them, may prevent the uterus from attaining its full growth, and compel it to early evacuation of its contents.

Symptoms and Diagnosis.—In dealing with a case of suspected miscarriage, we have to determine first that the patient is pregnant. This we do by a careful inquiry into the patient's history, and a complete physical diagnosis. Supposing that, by the usual investigation into the signs and symptoms of pregnancy, we are satisfied that gestation had begun, we have next to ascertain whether miscarriage is only threatening to come on, has fairly set in, or has already been completed.

The symptom that, in the great run of cases, first attracts attention, which usually goes on till the process is completed, and which continues for some hours or days subsequently, is hæmorrhage. The amount of blood lost varies indefinitely; and so does the manner of its escape. In certain cases the onset of pelvic pains, with the regular intermissions that betray their origin in the muscular contractions of the uterine walls, alarms the patient and attracts her attention before any escape of blood has taken place. These cases are exceptional. Usually the hæmorrhage precedes—and it may be for days or weeks—the expulsive action of the uterus. The cases, however, are rare unless they be instances of very early abortion, where the process is completed without the accession of appreciably painful contractions. Occasionally there occur discharges of liquor amnii or other watery fluid, or of fragments of the degenerated membranes, or of the disintegrated fœtus.

These symptoms call for physical exploration of the uterus. If we find the uterus gravid, with the os undilated and the cervical canal above it unexpanded, the hæmorrhage being slight and the pains controllable, we regard and treat the case as one simply of threatened abortion. But if the pains are persistent, if the os uteri opens to admit the finger, or the canal of the cervix above it is becoming expanded; still more, if the uterine contents are being pressed down within reach of the exploring finger, we have to do with an actual abortion which it is useless to seek to avert. The treatment of actual abortion is often enough called for, even with quiescent uterus and closed canals, when the hæmorrhage is profuse.

In trying to determine whether the miscarriage is completed, we have first to examine the mole or mass that has been expelled. This consists sometimes of the ovum alone; of the ovum and decidua reflexa; or of the ovum with all the uterine deciduæ. Where the uterine contents escape in broken-down fragments, and cannot be satisfactorily pieced together, it becomes necessary to examine the uterus, and even to explore the interior of that organ with the finger; and in these and other cases where the diagnosis is doubtful, it may be requisite sometimes to dilate the cervix with a carbolized sponge-tent, in order to get full access to the uterine cavity.

Treatment.—The treatment of miscarriage varies according as we have to do with a case of (1) threatening abortion; or (2) abortion in actual progress.

*Treatment of threatening abortion.*—The treatment in a case where abortion is merely threatening is largely expectant. The patient is put to bed and kept at rest in the recumbent position

All exercise or excitement, physical or psychical, must be forbidden. A light, non-stimulating diet, with fluids for the most part cold, is to be enjoined; and any tendency either to constipation or to diarrhœa is to be combated. Where the hæmorrhage is continuous and the uterus atonic or flaccid, small doses of ergot—twenty drops, every six or eight hours, of the extractum ergotæ liquidum—are useful. Dilute sulphuric acid or gallic acid, either alone or in combination with digitalis, may be administered. Where there are occasional pains accompanying the discharge, the best effects are obtained from the administration of opiates, which may be prescribed in the form of the acetate of lead and opium pill. Where the pains constitute the more urgent symptom, and the hæmorrhage is less, it may be well to check the uterine action at once by the use of an anæsthetic followed by opiates, or the administration of a dose of chloral; and the astringent may then be dispensed with. The opiates in such cases are best administered hypodermically or *per rectum*.

*Treatment of actual abortion.*—Where the stage of expectancy is clearly over, and the patency of the os internum, the persistence of the pains, or the profusion of the hæmorrhage, calls for active interference, there are two main indications to be fulfilled, namely, to restrain the hæmorrhage; and to ensure the complete evacuation of the uterus.

To restrain the hæmorrhage we compel the uterus to more energetic contraction, first, by the administration of large repeated doses of ergot. A drachm of the liquid extract may be given every three or four hours; but the effect of the drug can be most speedily and safely ensured by the hypodermic injection of ergotin—according to some such a formula as this:—℞ Ergotin. ʒij; chloral hydratis, ʒss; Aquæ destillatæ, ʒvi—16 drops to be injected into the gluteal muscle. The dialysed solution of ergotin is said to produce less irritation. Secondly, the genital canal must be plugged. Where we have no other means at command of checking the discharge, a carefully applied vaginal tampon may be trusted; or the vaginal plug may be used where the hæmorrhage is going on, but there is still some hope that the abortion may be arrested. Where the indication is more urgent, the introduction of a sponge-tent into the cervical canal is very much more satisfactory, and in every way more efficacious. It arrests the hæmorrhage immediately and inevitably; it excites the uterus to more energetic action; and it at the same time expands the cervical canal in all its length.

The complete evacuation of the uterus may take place by the unaided efforts of its muscular walls. On visiting a patient in the morning, who had a sponge tent passed into the cervix uteri, and a hypodermic injection of ergotin over night, we may find sponge and ovum and all expelled. Where the ovum is still *in utero*, if it be loose and the cervix dilated, compression of the uterus from above the pubes may suffice to make it expel its contents. Usually, however, it becomes necessary to get at the interior of the uterine cavity with a finger or fingers passed through the vaginal canal. In most cases it greatly facilitates the operation to anæsthetize the patient, and in some cases the previous administration of chloroform is absolutely necessary. To render the uterus accessible to the exploring fingers, it must either be pushed down from above or dragged down from below. The patient lying unconscious on her back, the fundus uteri may be depressed by the left hand pushed firmly and steadily down through the pelvic brim. The depression may be effected by an assistant, but never so satisfactorily as by the operator himself. Not less than two fingers of the right hand should be used for the internal manipulation; the middle finger being folded in the fornix vaginæ, whilst the index passes through the os to the fundus uteri, and sweeps round the entire ovum, detaching it at any adherent points. Sometimes the middle finger more conveniently enters the uterine cavity; and in most cases of miscarriage in the fourth month, the whole hand, except the thumb, may require to be passed into the vagina, and two or more fingers into the uterine cavity. Even where the vaginal orifice is not at first very wide, if the hand be carefully warmed and soaped, and the interstices of the fingers filled up on their palmar aspect with a quantity of half-melted soap, sufficient dilatation is speedily effected. Occasionally the smaller left hand may be employed for internal manipulation, while the stronger right is engaged in making the external pressure on the fundus uteri. Access to the interior of the uterus may in most cases be gained more easily by dragging the uterus down from below. One or other of the lips of the uterus—usually the anterior—is seized with a vulsellum, double or triple pronged, and slightly curved. One of the blades grasps the vaginal aspect of the front lip of the cervix as high up as the roof of the vagina, the other at a corresponding level within the cervical canal. The uterus is capable of being drawn far down without any injury to its ligaments, or any laceration by the bite of the vulsellum. It may be pulled down with the right hand and kept fixed by it, whilst the fingers of the left pass into the cavity, and explore and evacuate it. Or the vulsellum may be held in the left hand, or given to an assistant, to keep the uterus depressed, whilst the more familiar right-hand fingers do the intra-uterine work. The finger or fingers that have detached the ovum commonly succeed in extracting it, aided sometimes by pressure with the other hand from without. If not, there is no objection to laying hold of the loosened body with a pair of long dressing forceps, or a Lyon's or polypus forceps, and so withdrawing it; but no such instrument, even though it bear the name of abortion-forceps, ought to be trusted to for the detachment of a retained ovum or fragment of adherent placenta. The separation should always be effected by the direct action of the living finger.

*After-treatment.* — The uterus having been completely emptied, the patient should be kept at absolute rest in bed, and subjected to the same treatment as an ordinary puerperal female.

ALEXANDER RUSSELL SIMPSON.

**MITRAL VALVE AND ORIFICE, Diseases of.** *See* HEART, VALVES OF, Diseases of

**MODIFIED.**—A term applied to a disease, or to any of the phenomena of a disease, such as an eruption, when, as the result of a recognised cause, they present unusual characters, or run an unusual course. Thus, small-pox is modified by vaccination. *See* SMALL-POX.

**MOFFAT, in Scotland.**—Sulphur and also chalybeate waters. *See* MINERAL WATERS.

**MOGIGRAPHIA** (*μόγις*, with difficulty, and *γράφω*, I write).—A synonym for writer's cramp. *See* WRITER'S CRAMP.

**MOLE.—MOLAR PREGNANCY.**—The moles that are met with in obstetrical practice may be conveniently divided into two classes, (A) the *false*; and (B) the *true* moles. The false moles may be briefly dismissed, but it is desirable that they should be discussed, in order to clear the ground for the consideration of the more important variety.

A. **False moles.**—False moles are not the result of conception. Substances discharged from the virgin passages are occasionally so called; for example, shreds of vaginal mucous membrane, which the microscope should recognise. There is more difficulty, however, with the membranes of membranous dysmenorrhœa, where the discharged tissues may be mistaken for true decidual membranes. The circumstances attending each case must be nicely weighed, such as the history of previous attacks, the absence of the signs or symptoms of pregnancy, and so on. Again, if the discharged membrane happen to be complete, the two openings of the Fallopian tubes and that of the cervix will be found, a condition which does not obtain in true deciduæ. Microscopical examination will also aid in the diagnosis, by proving the presence or absence of structures belonging to the fecundated ovum. Blood-clots, variously altered, may also be discharged by the non-pregnant, and give rise to doubt and difficulty; especially those partially decolourised clots, which consist mainly of fibrin, the serum and red blood-corpuscles having to a great extent escaped. The blood is probably hyperinotic in these cases. Careful examination is necessary to determine the true nature of the expelled product. Nothing should be pronounced to be a true mole which does not present structures known to occur only in the fecundated ovum. Polypi and small fibroid tumours, or portions of large ones, are not difficult of recognition by naked-eye and microscopical examination.

B. **True moles.**—True moles are always the result of impregnation. The embryo may speedily disappear in the early stages, and then we meet only with the membranes or appendages; these, however, are characteristic.

Two chief varieties of true mole are at present recognised, namely, (1) the *fleshy*; and (2) the *vesicular* or *hydatidiform* mole.

1. *Fleshy mole.*—ÆTIOLOGY AND PATHOLOGY. Extravasation of blood between the maternal and fœtal structures of the fecundated ovum, or into the tissues of the latter, appears to be the active agent in the production of the fleshy mole; though it is difficult to determine the agencies whereby this condition is brought about. A diseased state of the deciduæ may doubtless result when pregnancy supervenes upon chronic endo-metritis; or effusion of blood into the maternal structures may occur from cardiac disease. Again, syphilitic and other blood-dyscrasiæ appear to exert an influence; and perhaps the same may be said of acute specific diseases when they fail to excite abortion. It seems probable that degeneration of the embryonic appendages takes place as the initial lesion in some cases, it may be from syphilis. The pathology of the subject is still, however, shrouded in considerable obscurity.

DESCRIPTION.—Whatever may be the exciting causes, when once blood has been effused into or between the fœtal and maternal structures, the vitality of the embryo is speedily compromised. The common result of this is abortion; but when the whole ovum is not thrown off, growth may take place in the remaining tissues, while the effused blood becomes organised and gives bulk to the mole. Not unfrequently a considerable effusion of blood takes place immediately beneath the amnion, encroaching greatly upon, and sometimes rupturing, the amnionic sac. The inner aspect of this cavity then presents an irregularly nodular appearance, and is of deep, almost black, colour. When the nodules are incised they are seen to be composed of firm blood-clot. If not immediately thrown off, growth may continue in the tissues, and a bulky, fleshy mole may result. The connection between the ovum and the womb being most intimate at the placental site, changes go on most actively at that spot; and when blood is largely effused here it constitutes what is called 'apoplexy of the ovum.' Examination of carneous moles seems to show that, under certain circumstances, the decidua vera is the chief seat of degenerative changes; but it appears that in all cases chorion villi may be found, though much altered by the presence of fatty and molecular matter.

The growth of fleshy moles may be rapid, but ordinarily it is not excessively so: such, at least, is the experience of the writer. Fatty degeneration may be extremely marked, and in rare cases calcareous degeneration may be met with, forming what the Germans call the *Steinmole*; but it must never be forgotten that similar degeneration of other uterine bodies may occur, for example, of fibroids, so that calcareous bodies are not to be looked upon as true moles unless other clear evidence exists of conception having taken place. Blood-polypi are occasionally met with, arising after miscarriage or delivery at full term, in which, organisation having taken place, and communication being established between the clot and the uterus, degenerative changes go on to the extent of calcification, whereby a so-called *Steinmole* may be produced.

2. *Vesicular mole.*—The vesicular, hydatid, or hydatidiform is the better understood, if not more important, variety of true mole.

DESCRIPTION.—It is necessary to state at the outset that the name 'hydatid' mole is erroneous and misleading. There are no true hydatids or ecchinococci in it. The physical arrangement of the vesicles is different. True hydatids are closed sacs, contained one within another, while the vesicular mole is formed by saccules growing

from one another. It was formerly supposed that they grew from a common stalk, and they were likened to a bunch of grapes or currants; but, for the reason given above, that simile was imperfect. The vesicles vary in size from a chestnut to a pin's head, or less; usually they are about the size of small currants; and as a few may from time to time escape, accompanied by more or less sanguineous discharge, Gooch's simile of 'white currants floating in red-currant juice' is a very apt one.

All authorities agree that the vesicles grow from the chorionic villi. There is no new formation, but excessive and erratic development. Mettenheimer, Paget, Barnes, Virchow, and others concur in this view. Whether the change is the cause or consequence of the death of the embryo is unsettled. Leishman points out that the period within which degeneration of the chorionic villi may originate does not extend probably beyond the tenth week, that being the period of greatest activity in the growth and multiplication of the villi. Later on, when blood-vessels have occupied the bulk of the villi, this kind of degeneration seems incapable of formation. The probabilities, therefore, are in favour of the formation taking place in the first chorion, or vitelline membrane. In reference to this portion of the subject it may be well to remark that recurrence of vesicular growths has occasionally, though rarely, been met with after apparent removal of vesicular moles from the uterus. Probably some portion escaped detection in those cases, and growth went on therein. Dr. McClintock mentioned this many years ago, and several cases are on record.

The connection between the vesicular mole and the uterus may be extremely intimate, some vesicles penetrating the uterine wall even to the peritoneum. Barnes states this, and Schroeder refers to a case by Volkmann and one by Jarotsky and Waldeyer, in which it occurred. The occasional recurrence of this variety of mole may be explained by portions imbedded in the uterine wall escaping removal, or resisting expulsion. The penetration of the uterine parietes may also favour rupture of the organ during the expulsion of a vesicular mole, as in a case recorded by the late Dr. Tyler-Smith.

The vesicular mole belongs to the class of pathological products known as myxomata. According to Gscheidlen the cyst-fluid contains albumen, mucin, phosphates, and other inorganic salts, leucin and tyrosin in small quantities, but no trace of fibrinogenous substance, paralbumen, or sugar.

An analogous degeneration of the placenta has been described by Virchow and Hildebrandt as 'fibrous myxoma' of the placenta. Schroeder quotes cases of 'diffuse myxoma' of the placenta, by Breslau and Eberth, and Spaeth and Wedl. A case of myxoma, or hyperplasia of the chorionic villi, is related by Dr. Sinclair in vol. i. of the *Publications of the Massachusetts Medical Society*.

Symptoms.—The symptoms of vesicular molar pregnancy are at first usually those of ordinary pregnancy, but patients often complain of malaise. The bulk of the uterus increases with great and disproportionate rapidity. There is a tendency to the loss of the ovoid form, and the assumption of the globular or more transversely wide shape. Generally there is early evidence of the presence of some derangement, by the appearance of watery and sanguineous discharge. When vesicles come away the diagnosis is clear; but in their absence the practitioner may be puzzled. In other cases there may be high temperature, quick pulse, an icteric tint of skin, and a dry or glazed tongue.

Physical examination often yields important information. Palpation may give, as Leishman remarks, a significant sensation of bogginess, with absence of the irregular fœtal hardness. Hardening under manipulation is very significant of the uterine nature of the tumour. On vaginal examination a doughy sensation may be experienced in the lower segment of the uterus. Should the os be open, vesicles may be felt. To the touch they somewhat resemble recent blood-clots. In all suspicious cases discharged materials should be carefully examined.

Treatment.—The treatment of all these cases of mole pregnancy consists in the complete removal, whenever practicable, of all the diseased tissues. Dilatation of the uterus may be necessary for this purpose, either by the finger or by means of tents, or Barnes's bags; and ergot and other oxytocics may be called for to aid in the expulsion of the offending product in some cases.

The diseased tissues should, if possible, be completely removed. Portions may be retained, after the bulk has been removed or expelled, and give rise to grave and exhausting discharges, or to recurrence, as has been mentioned above. It is important to remember, in this connection, that twin pregnancies may occur in which vesicular degeneration affects the membranes of but one ovum. It is well, therefore, to bear in mind the possibility of this; and that the sound ovum may proceed to full development. This state of things is said to have occurred on the occasion of the birth of the celebrated anatomist Beclard.

Alfred Wiltshire.

**MOLE, in Skin-Diseases** (A.S. *mâl*).—A term applied to certain permanent out-growths of the skin. They are usually congenital, and are termed *nævi* or 'mother-marks.' When covered with hair they are called 'hairy moles,' or *nævi pilosi*; and when of a dark colour, 'pigmentary moles,' *nævi pigmentosi*. Another synonym of the pigmentary mole is *spilus*.

Treatment.—The most convenient mode of treatment of all these kinds of mole is the careful application of a strong solution of potassa fusa, two parts to one of water. They are thereby converted, in the course of a few minutes, into a transparent gelatinous mass, which dries up into a black scab; and they are rarely reproduced when removed in this manner.

Erasmus Wilson.

**MOLIMEN** (*molior*, I move or stir).—An impulse or effort. The word is chiefly used in connection with menstruation, to indicate the effort which appears to be made by the system to perform this function. *See* Menses, or Menstruation, Disorders of.

**MOLLITIES OSSIUM** (Lat.).—Synon.: *Osteomalacia*; *Malacosteon*; Fr. *Ramollissement des Os*; Ger. *Knochenerweichung*.

Definition.—A condition in which the bones of the skeleton become by degrees decalcified, so that they can no longer sustain the weight of the body, but bend or break on slight provocation.

Mollities ossium has been called an excentric atrophy; but the minute changes which occur are not those of atrophy, but rather of active decalcification of the bone.

Ætiology and Pathology.—The causes of mollities ossium are unknown. It affects the female sex almost exclusively; only occurs in adults, and during the period of child-bearing. There is some intimate connection between the outbreak of mollities ossium and the gravid state; and repeated pregnancies appear to predispose to its occurrence. It also, but very rarely, is observed in the male sex. The disease seems to occur in the lower classes of the people, who are exposed to hardship and have inadequate food. In certain localities it would seem to be endemic. It has been ascribed to changes in the nutrition of the bone; to a process akin to chronic osteitis, or osteomyelitis; and to the action of an excess of lactic acid in the blood. This acid is said to have been found in the bones and urine of persons affected by the disease.

Anatomical Characters.—The bone in mollities ossium becomes gradually decalcified, the change spreading from within outwards, until a mere shell of external compact tissue is left, but this cortical layer never wholly disappears. The medullary cavity enlarges in all directions, occupying the epiphysis, and invading the cortical substance, until the interior becomes a gelatiniform mass, enclosed in a periosteal shell. The bone can be cut into layers with a knife, or indented with the pressure of the finger.

In the stage of acute progress the medulla is very vascular, the vessels are enlarged, and here and there extravasations of blood occur. The medullary spaces are filled with nucleated marrow-corpuscles; the trabeculæ give way; the osseous particles disappear; the fat-cells diminish, and gradually disappear; and finally the whole interior is filled with a pale or yellowish gelatinous substance, resembling the vitreous body. In extreme cases the external covering may be solely the fibrous periosteum, with a few plates of bone in its interior.

Symptoms.— One of the earliest symptoms of mollities ossium is aching rheumatoid pains in the affected bones, generally aggravated at night. The vertebral column, the ribs, and the pelvis are the parts first affected; and in these serious deformity shortly becomes manifest. The weight of the body causes extreme lateral and angular curvatures. The ribs are bent and broken; one series of fractures taking place in the axillary line, usually directed inwards, is produced by external pressure; whilst a second and third row of fractures take place by more indirect force—the one near the head of the ribs, the other outside the sternum. The arms often lie in a trough-shaped hollow on the sides of the body. The sternum gives way in several places, and is displaced forwards.

Through the weight of the body acting from above, the promontory of the sacrum is projected forwards, whilst the lateral pressure of the head of the femur, against the acetabulum, causes the transverse diameter of the pelvic outlet to diminish. It thus assumes a trifoliate shape, the pubic symphysis often projecting forwards at right angles to its normal position, with its two horizontal rami in contact. The floor of one acetabulum may even touch the other. The bones of the extremities suffer from multiple fractures and bending from the most trifling causes; and these are very imperfectly repaired in the later stages of the disease, although in the earlier they unite readily by bony callus. As the disease progresses, the body becomes more and more misshapen; the patient more perfectly helpless and bedridden; and death usually ensues from exhaustion, after a more or less protracted interval, or the sufferer is carried off by intercurrent disease. Female subjects frequently die in consequence of severe instrumental interference required during pregnancy. There is no constitutional cachexia.

Diagnosis.—The diagnosis of mollities ossium is at first very obscure. The pains resemble those of rheumatism. The character of the deformity will, however, settle any doubts. The disease should not be confounded with rickets, which is a disease of infancy or childhood, due to delayed ossification, and producing prominent curvatures of the shafts of the bone, and enlargements near the epiphyses, very distinct in type from the infractions and extravagant distortions of the osteomalacic skeleton. Nor does mollities resemble the fatty atrophy of bones due to senile changes, in which condition, though fracture be common, there is no general deformity involving different parts of the skeleton.

Prognosis.—The prognosis in most cases is unfavourable. In some well-marked cases of softening, the bones appear to have afterwards recovered their normal consistence, but this is very unusual.

Treatment.—No remedial measures, as yet discovered, have either arrested the progress of mollities ossium or promoted its cure. Women affected in this way should be restrained, if possible, from further childbearing, not only to avert increase of the disease, but to avoid the dangers attending childbirth in cases of deformed pelvis. Otherwise, an ample supply of nourishing food, rest in the recumbent position, and abundance of fresh air, are, combined with iron and quinine internally, the principal means of treatment at our disposal.

William Mac Cormac.

**MOLLUSCUM** (*mollis*, soft). — Definition.—A term applied to soft tumours of the skin.

Structurally, molluscum is an overgrowth of the connective tissue, and therefore a fibroma; hence it is named by Virchow *fibroma molluscum*. But there is another tumour of small size, rarely larger than a pea, which has been described as an overgrowth of the sebaceous glands, but recently as a specific degeneration of the cells of the rete Malpighii. In England observation proves the contagiousness of this affection—*molluscum contagiosum*.

Description.—Pathologically the fibromatous

molluscum is an hypertrophy of the connective tissue of the superficial stratum of the integument, infiltrated with serum, which renders the tumour more or less œdematous, and gives it its character of softness. It may range in size from that of a millet-seed to that of an orange or large melon. Occasionally even, as in a remarkable case illustrated by Virchow, small mollusca were protruded from the surface of one of very large size. The molluscum will also vary in density, in proportion to the firmness or relaxation of the connective tissue, and the quantity of fluid contained within its meshes.

Sometimes the molluscous growth is not restricted to the form of a tumour, but occupies a large extent of the integument, such as the whole circumference of a limb, and gives rise to immense folds and lobes which overhang each other in festoons, suggesting the term 'dermatolysis,' applied to this variety by Alibert. At other times the tumour grows in length, expanding as it proceeds, until, issuing from a narrow base, it develops into a mass resembling distended intestines.

The blood-vessels of molluscous tumours are always large, particularly the veins; but in the exaggerated forms of the disease the latter are prodigious in size, and may be seen through the skin twining around the base of the lobes.

TREATMENT.— The treatment of molluscum consists in the removal of the tumour. When the latter is of small size this may be accomplished with the scissors, but when it assumes the gigantic proportions already mentioned the operation is a serious one. Mr. Pollock, in a case of this kind, secured the large vessels by means of a ligature before proceeding to the employment of the knife. To treat *molluscum contagiosum* we must slightly enlarge the opening with a lancet, and press out its contents. The capsule then contracts or dies.

ERASMUS WILSON.

**MONOMANIA.**—SYNON.: Fr. *Monomanie*; Ger. *Wahnsinn.*—This term is falling into disuse on account of its vagueness, and because it has been employed by various writers to denote different kinds of insanity. Some have used it to denote an insanity which is indicated by some one particular delusion, the mind remaining clear on every other point. Others mean by it an insanity without delusion, an *affective* or *impulsive* insanity, the essence of which is the absence of delusion, and the so-called integrity of the intellectual portion of the mind. Esquirol thought it a disorder of the faculties limited to a few subjects, with excitement, and gay and expensive passion; while according to others, melancholia without delusion would be an instance of affective monomania. We may take it, however, that all authors are agreed in using the term monomania to indicate a partial insanity, which enables the patient to converse and act rationally to a considerable degree, and therefore renders his responsibility a matter of question. Such cases form the grounds of forensic contests, whether criminal or civil; but it is better to affix to them some more precise term, and to indicate symptomatologically and pathologically the exact nature of the mental and bodily condition of the alleged lunatic.

G. F. BLANDFORD.

**MONSUMMANA, Cave of; in Upper Italy.**—Natural vapour baths. *See* MINERAL WATERS.

**MONT DORE, in France.**—Simple thermal water, containing arsenic and soda. *See* MINERAL WATERS.

**MONTPELLIER, in South of France.**—Variable, fairly warm, winter climate. High winds from N.E. and N.W. *See* CLIMATE, Treatment of Disease by.

**MORAL INSANITY.** *See* INSANITY, Varieties of.

**MORBID** (*morbus*, a disease).—This word merely signifies *diseased*, and is used, in its several applications, as a technical or scientific term, in contradistinction to the term *healthy*. Among the most common examples of these applications may be mentioned *morbid anatomy* and *histology*, which imply the anatomy and histology of diseased conditions; *morbid sensations* or *feelings*, as distinguished from healthy sensations, whether connected with either of the ordinary senses, or with some particular organ, such as appetite; *morbid actions*; *morbid secretions* or *discharges*; and *morbid growths*. The word is employed in a somewhat special sense, in relation to individuals who are mentally low in spirits and despondent, without any obvious cause to account for this condition; such individuals are often spoken of as being in a *morbid state*.

**MORBIDITY** (*morbus*, a disease).—This term, which is of recent introduction, is employed to denote the amount of illness existing in a given community; and, as 'mortality' expresses the death-rate, so 'morbidity' indicates the sick-rate, whether the diseases be fatal or not.

Since health is an extremely ill-defined state, marked out by no absolute boundaries, and since many people suffer from diseases that are concealed intentionally or through ignorance, it becomes a matter of considerable difficulty to express with certainty the amount of illness that may exist at any time. Some information may, however, be obtained from the records of sick-clubs and benefit societies, on which statistics may be based of the average time their subscribers are ill during the year, in relation to employment, age, locality, and other circumstances.

By an investigation of this subject the rates of mortality come to possess an extended significance, for they thus indicate not merely the proportion between the living and the dead, but between the latter and the two classes of the living, namely, the healthy and the diseased; and, as a branch of State medicine, must doubtless come to take a prominent place. As further knowledge provides accurate facts and figures, the subject will have a distinct practical bearing, in estimating the value of men for work, if the average liability to disease and the total amount of illness an individual may expect to suffer be known; while it is reasonable to believe that as the 'aptitudes to disease' are further conditioned, the means for prevention may be extended.

W. H. ALLCHIN.

**MORBIFIC** (*morbus*, disease, and *facio*, I make).—This word is properly applied to any

cause that produces a disease. Such a cause is often spoken of as a *morbific agent*.

**MORBILLI** (dim. of *morbus*, a disease).—A synonym for measles. *See* MEASLES.

**MORBUS.**—This is the Latin word for *disease*. Formerly it was frequently employed, but is not much in vogue at the present day. When applied to particular diseases, it is associated with some qualifying adjective or noun, indicating the nature or seat of such disease, some peculiarity by which it is characterised, or the name of some renowned authority upon it. It would not serve any useful purpose to give a list of the diseases with which the word is connected, and it will suffice to cite, as examples, some of its more common applications, such as *morbus cordis*, disease of the heart; *morbus coxæ* or *coxarius*, disease of the hip-joint; *morbus cerealis*, ergotism; *morbus Brightii*, Bright's disease; *morbus cæruleus*, blue disease.

**MOROCCO, in North Africa.**—Warm, healthy winter climate. Tangiers is exposed to cold, damp S.W. winds in autumn and spring, and to E. winds. Living superior to Malaga. *See* CLIMATE, Treatment of Disease by.

**MORPHIA, Poisoning by.** *See* OPIUM, Poisoning by.

**MORPHŒA** (*morphœa*, a blotch).—This word has been used at various times as a synonym of lepra alphoides or alphos, and leuce, and is allied in meaning with vitiligo. More recently it has served to distinguish a circumscribed form of scleroderma. Four varieties of morphœa have been recognised—namely, *morphœa alba*, *nigra*, *tuberosa*, and *atrophica*; but a better knowledge of the pathology of the disease will probably merge the whole of these varieties in scleroderma. *See* SCLERODERMA. ERASMUS WILSON.

**MORTALITY.**—SYNON.: Rate of Mortality; Death-rate; Fr. *Mortalité*; Ger. *Sterblichkeit*.

DEFINITION.—The proportion of persons dying to those surviving under given circumstances; or, more usually, the proportion borne by the persons who die to the whole number of those subjected to the given circumstances.

Thus we may have to do with the annual mortality of the population of a country, a district, or a city; or of a body of men similarly circumstanced, as of clergymen or of lead-miners; or of bodies of men otherwise alike, but subjected to different conditions of climate, &c., as the British army; or of the population, or any section of the population, at special ages, as of infants in factory towns.

Or we may be concerned with the proportions of deaths to survivors, or to the whole number of entrants, during and after exposure to a special cause or causes of death, operating either speedily or during a protracted period. Hereunder come, for example, the mortality sustained by the population of Rio Janeiro, or New Orleans, during an epidemic of yellow fever; or that suffered by a number of persons in passing through an attack of enteric fever or pneumonia.

ESTIMATION OF MORTALITY.—The annual mortality of a population is reckoned, not on the numbers in existence at the beginning of a year, but on the average number in existence on the several days of the year, or, what is nearly the same thing, on the mean population of the year. The necessity of this becomes evident, when we consider that in our own country the large towns are mostly increasing at a very rapid rate, while some agricultural parishes and unprosperous places actually decline in population. In the towns, therefore, the death-rate, if reckoned on the last census, or even on the number believed or estimated to exist at the beginning of the given year, would come out higher than it ought to be, while in declining parishes it would be somewhat too low. Similarly the annual mortality of bodies of troops is calculated on the mean strength.

Two formulæ are in use for specifying death-rates. In the first the proportion of deaths is taken as unity: thus, the mortality in England and Wales in 1878 would be stated as 1 in 46. In the second, which is more convenient and is now generally employed, the number of lives at risk is taken as 100 or 1,000: thus the mortality of 1878 would come out 21·7. Either formula is convertible into the other by simple division: thus $1{,}000 \div 46 = 21{\cdot}7$; and $1{,}000 \div 21{\cdot}7 = 46$.

The death-rates of large civilised countries, in which registration is strictly carried out, give a pretty fair representation of the viability of the population. So much may be said for England, Wales, and Scotland, and for most of the European States, but not, unfortunately, for Ireland, where the weakness of the registration laws makes the record defective.

MORTALITY OF NATIONS.—The following are the death-rates per 1,000 of most of the principal States of Europe:—

| | In years. | Per 1000 living. |
|---|---|---|
| Norway | 1846–55 | 17·9 |
| Sweden | 1869–78 | 18·9 |
| Denmark | „ | 19·2 |
| England and Wales | „ | 21·8 |
| Scotland | „ | 22·1 |
| Belgium | „ | 22·6 |
| Switzerland | 1870–78 | 23·5 |
| France | 1869–78 | 24·3 |
| Or excluding two years of war | | 22·5 |
| Netherlands | 1869–78 | 24·4 |
| German Empire | 1872–78 | 27·2 |
| Italy | 1869–78 | 29·5 |
| Spain | 1861–70 | 29·7 |
| Austria | 1869–78 | 31·1 |
| Hungary | 1868–77 | 39·6 |
| Or excluding two cholera years | | 36·1 |

The death-rate of Russia, except in the extreme north, is high. It was stated at 35·9 in 1842. That of Portugal the writer has not been able to obtain. Those of Turkey, of Ireland, and of Greece are unknown. In many of the British colonies it is lower than even in Norway. Thus the average mortality during the ten years, 1866–75, was in [1]

| | |
|---|---|
| Victoria, 15·8 | South Australia, 15·3 |
| New South Wales, 15·3 | Tasmania, 14·8 |
| Queensland, 17·7 | New Zealand, 12·4 |

MORTALITY OF CITIES.—The mortality of cities is in this country almost invariably higher than that of the open country. But this rule does not apply to all other countries; the exceptions occur mostly where endemic fevers are prevalent

[1] Hayter, *Australian Statistics*.

in the country. Thus the mortality rate in 1878 was in London, 23·5; in Edinburgh, 22·1, and in Dublin, 29·6; and in 20 other large towns in the United Kingdom it varied between 19· in Portsmouth, and 29·4 in Liverpool; while in 50 towns of the second class the extremes were 16·2 at Dover, and 18·1 at Rochester; 30·4 at Blackburn, and 30·8 at Preston; the average of the 23 towns being 24·4 per 1,000, and of the 50 towns 23·. In the same year the rural districts and small towns of England yielded an average rate of 19· only. There are a considerable number of districts, almost all rural, which year after year fall below 17; and 17 was accordingly fixed upon by the late registrar-general for England as a kind of standard to be aimed at by sanitarians. And there are districts in England, and entire small counties in Scotland, where the rate occasionally falls below even 15.

The following table exhibits the death-rates experienced in 1878 in a number of foreign and colonial cities:—

| | | | |
|---|---|---|---|
| Calcutta | 37·7 | Paris | 24·6 |
| Madras | 48·8 | Brussels | 28·0 |
| Bombay | 41·8 | Amsterdam | 24·4 |
| New York | 24·8 | Rotterdam | 27·3 |
| Brooklyn | 20·1 | The Hague | 26·4 |
| Philadelphia | 18·0 | Copenhagen | 22·0 |
| Montreal | 30·9 | Stockholm | 22·4 |
| Alexandria | 45·4 | Christiania | 18·5 |
| Melbourne, 1873 and 1875 | 22·8 | St. Petersburg | 47·1 |
| Rome (1878) | 29·8 | Berlin | 29·9 |
| Naples | 33·1 | Hamburg | 26·9 |
| Turin | 31·1 | Dresden | 24·7 |
| Venice | 28·7 | Munich | 34·6 |
| Trieste | 36·2 | Breslau | 29·9 |
| Geneva | 23·6 | Vienna | 29·6 |
| | | Budapest | 40·3 |

Analysis of Results.—These tables awaken, by the enormous differences between the several cities and countries, a curiosity respecting the causes of such differences, which, however, the figures themselves go far towards satisfying. It is at once evident that, whatever may be the case in the open country, cities suffer to a considerable extent in the ratio of their ignorance and neglect of sanitary laws, and of the poverty and squalor, or barbarism of their populations. Mark, for example, the contrast between Philadelphia and St. Petersburg! Cities having a steadily warm climate, or a climate of extremes, are more unhealthy than those which enjoy a temperate one. By this consideration, combined with that of their superior civilisation, may be explained the favourable position of the cities of Western as compared with those of Eastern Europe. The short, hot summers are very fatal in the latter region, and even in Southern Germany and at Stockholm; while in Western Europe generally, and especially in Scotland, winter and spring are the deadly seasons. It is noteworthy that in most of the large cities of Italy the short, sharp, and changeable winter is not less deadly than the hot summer and malarious autumn; in fact good winter climates for *poitrinaires* are exceptional even in Italy.

In Great Britain the influence of climate *per se* on the annual mortality of the several cities and districts is not very great; and its effects are obscured by those of other agencies. But if we confine our attention to the rural districts, where the disturbing factors are less important, we shall find that the rates of mortality are on the whole slightly more favourable in the north than in the south. Of all the counties in Great Britain Orkney-and-Shetland stands best, with an annual mortality, on an average of 10 years,[1] of 15·13; and Shetland, the more northern division, stands better than Orkney. Great Britain is, therefore, no exception to the rule that in Europe mortality decreases from south to north. This is in no way inconsistent with the fact that throughout Great Britain winter is the deadly season, and cold is more fatal than heat, thoracic than abdominal diseases.

Influence of Seasons.—The following were the death-rates of the four seasons in England and Wales, in 1868–77:—

| | Winter. | Spring. | Summer. | Autumn. | Year. |
|---|---|---|---|---|---|
| In the chief towns | 25·8 | 22·5 | 23·1 | 24·2 | 23·7 |
| In the small towns and rural districts | 21·7 | 19·3 | 17·2 | 18·5 | 19·0 |

In Scotland the seasonal mortality, owing, doubtless, to the less intensity of the summer heat, follows pretty nearly the order of the English small towns and rural districts. Thus, in 1878: winter, 25·2; spring, 23·2; summer, 19·8; autumn, 20·4; year, 22·3.

It would seem, however, that in London, in the early part of the seventeenth century, when the death-rate, owing to the closeness and filthiness of the city, was fearfully high, the maximum was attained in summer, the figures standing as follows in 1606–10, during which years the plague was absent. Average mortality per cent.:—winter (J. F. M.), 1·4; spring, 1·5; summer, 2·7; autumn, 2·0:—total, 7·0.

Influence of Density of Population.—In accordance with a principle already laid down, that in communities sufficiently advanced to furnish mortality statistics, the death-rate diminishes with the progress of civilisation, the mortality of London has since the seventeeth century gradually and greatly diminished. At the beginning of this nineteenth century it had sunk to 29, in 1840–49 it was 25·3, and in 1870–78 only 23.

The death-rate is also diminishing in France, Belgium, the Netherlands, Sweden, and Germany, in all of which countries the population is believed to be advancing in comfort and general well-being, but in southern and eastern Europe, where comparatively little advance has taken place in these respects, no such diminution can be demonstrated.

Nor, though evident in London and in several other great towns, can a diminution of the death-rate be positively affirmed of Great Britain generally. In Scotland, indeed, there was a decided increase from 1855 until 1876, when a decline, which may prove transient only, set in. And in England no improvement could be shown for many years before 1871, since which date there has been an almost unbroken succession of years of low mortality, concurring with a generally low temperature and excessive fall of rain.

[1] 1866–75.

The great antagonistic influence in Great Britain may be found in Dr. Farr's principle, 'That mortality increases with density of population.' And 'urbanisation' advances so rapidly in Great Britain, that all the efforts and devices of sanitary and medical science are scarcely able to do more than neutralise its evil effects.

Sources of Fallacy.—It may be as well to advert to some of the principal sources of fallacy, which hamper us in appreciating national and local death-rates. One of these is the varying number of births. This ranges in the Continental States of Europe from about 40 in Germany and Austria, and even more in Russia and Hungary, down to 25 in France; and in Britain from 48 or 50 in some coal and iron districts, down to 22 in the county of Sutherland. The late Dr. Letheby maintained that a high birth-rate was a direct cause of a high death-rate, owing to the great mortality among infants. This was an error; the two often concur, but the former is not a cause of the latter, unless where the infants perish in enormous proportion. The usual result in this country of a large and especially of an increasing birth-rate, is to augment in the community the proportion of children beyond infancy, and of young persons, who ordinarily suffer a very low death-rate as compared with old or even middle-aged persons. The favourable rates prevailing among these young persons overpowering the unfavourable ones of the infants, and of the comparatively small number of old people, the apparent death-rate is actually diminished, instead of being increased as Letheby supposed. And this points to the true reason why the death-rate of France is higher than that of England, whereas the expectation of life in the two countries is about the same at most ages, the birth-rate of France being exceedingly low (Bertillon). *The lower the average age of the population the lower the death-rate.*

A considerable amount of emigration or immigration affects the death-rate in proportion to the average age of the migrants. Thus the mortality of most great and growing towns would stand worse than it does, were it not for the large numbers of young and healthy persons from the country who settle in them. Watering-places and residential towns appear somewhat healthier than they really are, by reason of the numbers of young domestic servants who form a large portion of their population. But it is in our colonies that the effect of migration on the death-rate can best be studied. The unexampled death-rate of New Zealand, quoted above, is the result of two kinds of causes, one set of which we may call real, the other factitious or apparent. The former are the cool, equable climate, and the orderly and prosperous condition of the population; the latter are the constant stream of mostly youthful immigrants, and the very high birth-rate.

Influence of Age and Sex.—The influence of age and of sex on the mortality in England and Wales may be best shown in a tabular form.

Mortality per 1,000 at twelve groups of ages in males and females in the 41 years 1838–78 :—

| | All Ages | 0– | 5– | 10– | 15– | 20– | 25– |
|---|---|---|---|---|---|---|---|
| Males . . . . . | 23·3 | 71 | 8 | 4 | 6 | 8 | 9 |
| Females . . . . | 21·2 | 62 | 8 | 4 | 7 | 8 | 9 |
| | | 35– | 45– | 55– | 65– | 75– | 85– |
| Males . . . . . | 23·3 | 13 | 18 | 32 | 67 | 147 | 311 |
| Females . . . . | 21·2 | 12 | 15 | 28 | 59 | 134 | 287 |

The superiority of the women is here well-marked, except during childhood and the years of early married life and much child-bearing.

Influence of Race.—The influence of race is usually difficult to separate from that of habits of life. In Europe the Jews offer the most notable example. It may be sufficient to quote from Oesterlen Neufville's statistics of Frankfort-on-the-Maine, who found that there the average age of Christians at death was 36·9 years, but that of Jews was 48·7; and from Hoffman, the death-rate of the Jews of Prussia, which was only 21·6 per 1,000, against 29·6 among the Christians.

Influence of Station and Occupation.—The influence of station and occupation on mortality is very great. The subject has been carefully handled by Dr. Farr in the Supplement to the Registrar-General for England's thirty-fifth Report. Briefly, it may be said that of all trades or professions that can be isolated, clergymen, barristers, farmers, agricultural labourers, gamekeepers, grocers, seem to stand best in this respect. Booksellers, paper-makers, wheelwrights, and carpenters also suffer but a small mortality. Schoolmasters and teachers go on well up to fifty-five. Solicitors, domestic servants, watchmakers, shoemakers, blacksmiths, range not far from the average rates; so do bakers (though such is not the current opinion), and the whole tribe of weavers. The workers in iron, as a rule, experience but a low mortality in early life, but a high one as they grow older; the same may be said of millers, and, somewhat strangely, and no doubt for very different reasons, of Roman Catholic priests. Tailors begin very ill, and end fairly. Medical men, alas! perish frequently in early life, and only attain a respectable position after fifty-five. Chemists, too, and veterinary surgeons, come out badly. The figures for drapers much resemble those for medical men. Those for miners, naturally enough, are not much different from those for iron-workers, though a little worse. Tobacconists, as might be expected, suffer very heavily until middle life. Printers, bookbinders, clerks, commercial travellers, glass manufacturers, dock labourers, porters, railway employés, butchers, fishmongers, coachmen, draymen, grooms, all suffer a very high mortality. And the very worst positions are occupied by the dealers in alcohol and in lead (the painters), and by the potters.

These facts are of considerable practical interest in relation to questions of life insurance.

Mortality of Diseases.—Some acquaintance with the mortality of diseases, and the extent to which it is influenced by age, sex, climate, season, &c., is also of great value for prognosis.

Information on this subject will be found under the heads of the several diseases; moreover the limits of this article are not sufficient to admit of much discussion of the subject.

A few facts respecting the acute infectious diseases will, however, be of interest—

1. *Typhoid Fever.*—The average death-rate of enteric fever was put by Murchison, in accordance with British, French, and German hospital statistics, at 17·4 per cent. There is a good deal of ground for putting the average mortality of children and youths at 11 or 12, but it is probable that only the worst cases occurring in children find their way to hospitals. Over fifty years of age somewhere near one-half usually die (Liebermeister).

2. *Typhus.*—In typhus the mortality varies extremely in different epidemics, sometimes rising above the average of enteric fever, more often, perhaps, falling below it. In Ireland it is usually low, averaging perhaps 9 or 10 per cent., or less. The mortality of children from this disease is much lower than from enteric fever (Murchison, Lebert, &c.). The number of deaths ascribed to typhus (that is continued fever, including enteric) in the register, is, however, largest in proportion to the living under five years; is low from 10 to 15, and again from 25 to 35; and then increases gradually up to extreme old age. One cannot help suspecting that other febrile affections of children are confounded with typhus and enteric fevers.

3. *Measles.*—The mortality from epidemics of this disease is often as low as 2 or 3 per cent., but it has been known to rise to 30 per cent. under unfavourable circumstances, as where children, or even adults, are crowded together in a hospital. Among 'virgin' communities (as in well-known epidemics in Iceland, Färoe, Madagascar, Fiji) the mortality is sometimes frightfully large. It is comparatively small in summer; and decidedly small among the comfortable classes, owing doubtless to the exercise of greater care. It is beyond comparison greatest in the second year of life, and by the tenth has become quite trifling; but adults *may* die of measles.

4. *Scarlatina.*—There is a prodigious difference in the deadliness of different epidemics of this disease, even in the same locality. In Southern Europe it is comparatively a mild disease; in Britain it is most severe; yet even here eighty successive cases may occur without a death. But a mortality under 10 per cent. may be considered moderate (Thomas, in *Ziemssen*); it is often much higher. It is at its maximum from the second to the fourth year, but continues very deadly up to ten or twelve; by fifteen it has almost reached a minimum, but, unlike measles, continues to be somewhat formidable throughout life, especially to parturient women. Season and station in life make little difference in its deadliness.

5. *Smallpox.*—Smallpox did and does, in unvaccinated communities, where it has long been at home, destroy somewhere about 10 per cent. of the population; and of persons unprotected by vaccination, who are attacked, 40 per cent. often perish. Among 'virgin' communities it is still more deadly. Age makes comparatively little difference in its fatality.

6. *Whooping cough.*—The death-rate of this disease is very large in the first year of life, declining afterwards like that of measles, but rather more rapidly, and becoming quite insignificant before the tenth year. Whooping-cough is more fatal in winter than in summer, in towns than in the country, among the poor than among the rich; but these differences, except the first, are not very well-marked. JOHN BEDDOE.

**MORTIFICATION** (*mors*, death, and *facio*, I make).—A popular name for gangrene. *See* GANGRENE.

**MOTILITY, Disorders of.**—The power of executing movements of the different parts, or of the body as a whole, may be interfered with in various ways; and as such disabilities are generally partial, the particular movements that happen to be implicated will also differ amongst themselves in different cases.

The disorders of movement to be referred to in this place are principally those in which muscles of one of the limbs, or of other external parts of the body are concerned — though disorders of the same kind, and also of different degrees, are likewise frequent, in which we may find perverted movements of viscera and their ducts, as well as of blood-vessels: in other words, portions of the involuntary muscular system are apt to have their functional activity deranged, after some of the same modes as portions of the voluntary muscular system.

In such cases, almost without exception—and to whichever class the defects may belong—the disordered motility is due primarily to some defective or abnormal action of the nerve-centres or of the nerves in relation with the muscles implicated, rather than to any primitive disease of the muscles themselves.

CLASSIFICATION.—Disorders of motility are divisible into three primary classes, according as they show themselves (A) in response to voluntary incitations; (B) in response to mere 'reflex' impressions; or (C) spontaneously. The particular muscles implicated (or the mode of distribution of the various defects) will necessarily differ much according to the extent and situation of the disease in the nerve-centres or in the nerve-trunks to which the defects are due. In some cases particular defects of motility can be confidently referred to disease of the brain, and even of particular parts thereof; in others they may be referred to disease of the spinal cord in particular regions; or, in other cases still, they may be as clearly due to some altered condition of nerve-roots or of nerve-trunks in their continuity.

A. **Disorders of voluntary movements.** Under this head are to be included different varieties of disordered movement, thus divisible:—

1. *Diminution of motor power.*—This varies much in degree in different cases. There may be mere weakness (paresis) or actual loss of power (paralysis) of one or more limbs, or of particular sets of muscles. The type of the paralysis will vary according to the seat and extent of the lesion; thus it may be due to a cerebral lesion, and be of the hemiplegic type (*see* HEMIPLEGIA); or it may be due to a spinal lesion, and be of the paraplegic type (*see* PARA-

PLEGIA); or the loss of power may be owing to disease or injury of some nerve-trunk, and then be of the type of a peripheral paralysis, such as we get in facial palsy.

2. *Imperfect coördination of movements.*—Here the several muscles concerned with the production of a given movement act without the relative subordination and gradation of force needful for its proper execution. Some muscles contract too powerfully and others not enough, or some contract too quickly and others too slowly, with the effect of producing a spasmodic or otherwise disordered movement — one by which the end desired is not readily attained. The condition thus produced is known as '*ataxia*,' of which there are two principal varieties—one caused by disease of the posterior columns of the spinal cord (*see* LOCOMOTOR ATAXY); and the other by disease of the cerebellum (*see* CEREBELLUM, Lesions of). Ataxia is, in fact, a condition for the most part caused by the defects described in the previous category, together with that to be mentioned in the next, the two states co-existing (in different proportions in different cases) among muscles called into simultaneous or successive activity for the execution of various complex movements. A kind of ataxy may indeed be induced by mere paresis in some muscles of a physiological group, that is of some muscles whose business it is habitually to act in combination with others.

3. *Spasmodic action of certain muscles.*—On volitional incitations reaching the spinal cord in certain states of disease, some of the muscles whose contraction is to be brought about are thrown into a condition of over-action or tonic spasm, whereby the performance of the movement is greatly interfered with. In such cases there is almost always in addition increased reflex excitability, so that it is in some cases difficult to say how much of the spasm is primarily due to the volitional incitation, and how much to reflex spasms—caused by cutaneous impressions consequent upon the commencing movement. These conditions are especially met with in cases where portions of the cord are cut off from the so-called 'inhibiting' influence of the brain, at the same time that there is hyperæmia, with increased excitability of the then active regions of spinal grey matter. This state of things is particularly frequent in 'primary sclerosis of the lateral columns.' On the other hand, the initiation of voluntary movements may, in other cases, give rise to clonic spasms in the parts moved, especially in certain cases of disseminated or insular sclerosis. *See* SPINAL CORD, Diseases of.

4. *Tremors, shakings, or choreic movements.*—Tremors (fine or coarse) and shakings are really clonic spasms of limited range; and all gradations may at times be met with between these several types of disordered movement. Such morbid movements of one or other grade, even if they exist more or less continuously, are usually increased by volitional incitations. This is the case, for instance, in paralysis agitans; in the trembling from mercurial poisoning or from chronic alcoholism, as well as in that from senile changes; in the shakings met with in disseminated sclerosis; and also in the more irregular movements, often of wider range, met with in chorea. *See* CHOREA; SPINAL CORD, Diseases of; and TREMOR.

B. **Disorders of reflex motility.**—The conditions on which disordered movements, due to increase of reflex excitability, depend, have been above referred to. The withdrawal of brain-influence from, and the increased hyperæmia of certain tracts of spinal grey matter, seem to be the main causes, and these are met with principally in certain forms of paraplegia, and in spasmodic spinal paralysis, or primary sclerosis of the lateral columns. The mere weakening of cerebral influence will, however, lead to an increased manifestation of reflex movements, as may be seen in certain nervous or delicate persons, in infants, or in young children.

Two forms of reflex actions have to be discriminated, namely, those excited by cutaneous impressions—skin reflexes; and those induced by taps or slight blows upon tendons—tendon reflexes. Both forms are often unduly exalted in the same person, though sometimes the skin reflexes may be normal, whilst the tendon reflexes are greatly exaggerated.

Reflex movements of both kinds may be diminished, either (1) from disease of afferent nerve-roots outside or within the cord, as in locomotor ataxy; (2) from destructive disease of the grey matter of the cord, as in many cases of severe paraplegia; or (3) from disease of the motor roots or nerves supplying particular groups of muscles.

An increase or a diminution of reflex excitability is frequently met with, and is often of much importance, in connection with one or other of the viscera, such as the heart, the stomach, the bladder, or the intestines. This undue nervous excitability may be depend upon morbid conditions, partly of the medulla or spinal cord, and partly of portions of the sympathetic system.

As possible conditions of much importance in the ætiology of many nervous affections we may here also mention disordered activity of certain vaso-motor centres, which, either immediately or remotely, influence the calibre of the blood-vessels supplying certain portions of the brain or cord. In this manner there may be induced either spasm of their vessels, with greatly lowered blood-supply; or paralysis of vessels, with consequent hyperæmia in such nerve-centres. These conditions would correspond with the death-like pallors or the flushings occasionally observable in the face, or other tracts of skin. The doubt exists, however, as to how long such mere reflex pallors or flushings may persist in nerve-centres, that is, when they are simply due to functional defects. Are they always merely transient phenomena, or may they persist for days or even weeks, as some have supposed?

C. **Spontaneous movements.**—The movements which are manifested 'spontaneously' are various in nature or degree, though they are of kinds similar to those that may be excited by voluntary incitations. We need only enumerate these different varieties here, and briefly indicate either the diseases in which they are encountered, or the conditions on which they depend. (*a*) *Tremors*, such as present themselves in paralysis agitans, or mercurial poisoning; (*b*) *twitchings*,

or *startings*, occurring in one or more limbs, either upper or lower, in some cases of cerebral and of spinal disease; the more irregular but less spasmodic movements, known as (*c*) *choreic*, occurring principally in the disease from which they derive their name (being sometimes indefinite, and at others distinctly co-ordinated); (*d*) *spasms*, which may be either co-ordinated, as in some cases of chorea; clonic, as in epilepsy, eclampsia, and other allied affections; or tonic, as in tetany, tetanus, strychnia-poisoning, and certain spinal affections, as well as in some cerebral diseases.

Conditions of *rigidity* and *contraction*, due to a more or less permanent tonic spasm, are scarcely to be described under the head of spontaneous movements, since in such conditions, although there is powerful muscular contraction, there is no actual movement; and, similarly, the spontaneous *flickerings* of muscular fibres, seen in so many cases of progressive muscular atrophy, deserve to be mentioned here, even though no movements are produced, owing to the small number of muscular fibres involved at any one time. The flickerings themselves are really clonic spasms, involving a few fibres simultaneously.

Treatment.—The treatment of these different nervous conditions will be considered fully under the various special articles to which reference has been made.

H. Charlton Bastian.

**MOUTH, Diseases of.**—The principal diseases of the mouth may be thus enumerated in the following order:—1. Inflammation and its results; 2. Epulis; 3. Gumboil; 4. Ranula; 5. Salivary calculus; and 6. Salivary fistula. Diseases of the tongue and of the teeth are treated of in other articles

1. **Inflammation.**—Synon.: Stomatitis; Fr. *Stomatite*; Ger. *Mundschleimhautentzündung*.—Inflammation of the mouth is fully described under the heading Stomatitis. *See* also Aphthæ; and Cancrum Oris.

2. **Epulis.** — Synon.: Fr. *Épulide*; Ger. *Epulis*.

Description.—Epulis is the name given to a tumour which springs from the alveolar processes and from the periosteum covering them. It is more often seen in connection with the inferior than with the superior maxilla. It forms a smooth, rounded, or lobulated tumour, covered with the mucous membrane of the gum. It is firm or semi-elastic to the touch. As it grows, it loosens and displaces the teeth. Its intimate structure varies considerably. Sometimes it is a simple fibrous tumour; sometimes a round-celled sarcoma; sometimes a myeloid. At first it is benign; but if it be allowed to remain, it is apt to ulcerate, and exhibits something of a malignant aspect and character.

Treatment.—The tumour should be removed, and the portion of the alveolar process from which it springs should be taken away. Unless this be done, the growth is almost certain to return.

3. **Gumboil.**—Synon.: *Parulis*; Fr. *Parulie*; Ger. *Zahnfleischgeschwür*.

Description.—A gumboil is a circumscribed inflammation of the mucous membrane, or of the periosteum covering the alveolar processes. It is usually caused by the irritation of a decayed tooth. In a severe case the swelling, pain, and discomfort are great; and the constitutional symptoms often run high. When suppuration takes place the boil generally breaks, and a speedy cure is obtained. If, however, the pus cannot find a ready exit, it may burrow, giving rise to necrosis of the subjacent bone, or it may form sinuses in various directions—for instance, on the cheek.

Treatment.—The cheek should be poulticed, and the old-fashioned fig poultice is often applied to the gum with advantage. The mouth is to be frequently rinsed with hot water. The diet should consist entirely of fluids. An aperient should be given at the outset, and subsequently a suitable stimulant, such as ammonia and bark. As soon as pus can be detected, the gum should be lanced. When the acute inflammation has subsided, the source of irritation should be removed.

4. **Ranula.**—Synon.: Fr. *Grenouillette*; Ger. *Ranula; Fröschleingeschwulst*.

Definition.—Cystic formations in the mucous membrane beneath the tongue, which take their origin sometimes in the ducts of the sublingual or sub-maxillary glands, sometimes in the areolar spaces, and possibly also in the bursa between the genio-hyo-glossi muscles.

A. *Internal Ranula.*—Description.—The majority of cases of ranula are unconnected with the salivary glands; and, in many instances, a probe may be passed along the ducts, or the saliva may be noticed flowing from them, while the ranula remains unaltered.

Other cases belong to that simple variety which depends merely upon an accumulation of the normal secretions in a natural cavity, such as a duct, which has become temporarily obstructed. Such obstruction may arise from local inflammation, from inspissation of the normal fluid, or from the impaction of a salivary calculus, as will be subsequently described.

Treatment.—The majority of cysts in this situation lie just beneath the mucous membrane. They are, moreover, always small at their commencement, so that if the attention of the surgeon is called to them early, they can generally be cured by taking up a piece of the cyst-wall, and cutting it off with scissors; or a seton may be passed through the tumour and knotted, when the cyst will gradually contract.

B. *External Ranula.* — Description.—These are larger tumours, which lie between the tongue and the jaw, and become prominent at the upper part of the neck. Though the term *ranula* is applied to them, they are of a different character, and analogous to the sebaceous tumours which are so frequently met with in the skin, containing, like them, a thick, gritty substance of a fawn colour, often very offensive. This material is made up chiefly of epithelium, plates of cholesterine, and oil.

Sometimes these enlargements advance very slowly; but in other instances their progress is extraordinarily rapid, and then the disease is called *acute ranula*.

Treatment.—The cure of cases of this class is more difficult and tedious. The cyst should

be freely opened from the mouth; the contents scooped out; and the cavity filled with lint. Sometimes it is desirable to make a counter-opening in the neck, and to treat the disease as an ordinary abscess. Passing a seton may be useful. To dissect the cyst out is an unnecessary proceeding, and not always free from danger.

5. **Salivary Calculus.**—Synon.: Fr. *Calcul salivaire*; Ger. *Speichelstein.*

Description.—Concretions, composed chiefly of phosphate of lime, are not very uncommon in the ducts of the parotid, sub-maxillary, and sublingual glands. These calculi may vary in size from a pin's head to a filbert, or even larger. Not unfrequently they form around some small foreign body, such as a seed or a morsel of woody fibre, which has made its way into the duct. Occasionally they occupy the substance of the gland, but more often they are found in the duct. Here they may simply obstruct the outlet, and give rise to an accumulation of the secretion, forming a ranula, and inconveniencing the patient by forcing the tongue upward and backward; or they may cause a local inflammation which terminates in an abscess.

Treatment.—If a concretion can be felt, either with a finger or with a probe, an incision should be made and the calculus removed. If there is local inflammation, it should be fomented or poulticed; and, if an abscess forms, it should be opened and then treated in the same way.

6. **Salivary fistula.**—Synon.: Fr. *Fistule salivaire*; Ger. *Speichelfistel.*

Description.—Occasionally the duct of the parotid gland (Steno's duct) is wounded or involved in an ulceration, or an abscess forms in its track and bursts externally. In such cases a salivary fistula is likely to be the result. The secretion from the parotid, instead of making its way into the mouth, dribbles over the cheek.

Treatment.—The treatment of salivary fistula consists, first, in establishing an opening into the mouth by means of a few threads of silk, a wire, or a piece of catgut, passed from without inwards, brought out at the mouth, and the ends tied together. The next point is to close the skin of the cheek over the fistulous opening. This may be done by touching the edges with the actual cautery, so as to make them contract; by paring the edges, and bringing them accurately together; or by dissecting the skin around the wound, sliding it along so as to cover the opening, and securing it with stitches. But the cure of salivary fistula—a purely surgical proceeding—is always difficult, and a more or less depressed scar is sure to remain.

W. Fairlie Clarke.

**MOVABLE KIDNEY.** *See* Kidneys, Diseases of.

**MOVEMENT, Therapeutical Uses of.**—Synon.: Movement Cure; Kinesitherapeutics; Fr. *Gymnastique Suédoise*; Ger. *Kinesitherapie.*

Description.—The method of treatment of disease by movement appears to have been first designed by Ling, a member of the Royal Swedish Academy, about the beginning of the present century. The movements employed are said to be of three classes, namely: 1. *Active movements*, executed by the patient himself, or by the patient aided by an assistant; 2. *Passive movements*, performed by the assistant on the patient; and 3. *Acts of resistance to movements*, whether executed by the assistant against the patient, or by the patient against the assistant.

Uses.—The several classes of movements, for which mechanical arrangements are also contrived, when scientifically employed, are used in the treatment of paralysis, curvatures of the spine or limbs, and injuries and diseases of the joints. Movements of the nature of friction or shampooing are also employed in the treatment of certain diseases of internal organs, and will be found described elsewhere in this work. *See* Friction; and Shampooing.

**MOXÆ** (Eastern).—A term for a form of counter-irritation, which consists in producing an eschar by burning certain materials upon the skin of a part. Moxæ were originally prepared in Eastern countries from the leaves of the artemisia; but when used in this country, cotton-wool and other substances are employed. *See* Counter-Irritation.

**MUCOID DEGENERATION.**—A form of degeneration, which is associated with the production of a mucus-like substance. *See* Degeneration.

**MUCOUS MEMBRANES, Diseases of.** This class of membranes, which line organs and passages communicating with the exterior of the body, though presenting modifications as to their minute structure in different parts of the body, exhibit a general resemblance in their construction, and consist essentially of sub-mucous tissue; a basement-membrane; epithelium of various kinds covering the free surface; and numerous glands or follicles, differing in their characters in different tracts. They are highly vascular as a rule; and many of them are richly provided with absorbent vessels. It is only intended in this article to treat briefly, from a general point of view, the morbid conditions to which mucous structures as a class are liable. Those connected with the several mucous tracts are discussed under their appropriate headings.

1. **Injury.**—Most of the mucous surfaces are exposed to injury from various causes. This may come from without, the cause being either mechanical, chemical, or excessive heat. As illustrations may be mentioned injury to the mucous lining of the alimentary canal or air-passages by foreign bodies; corrosion from swallowing strong acids; and burning or scalding of the mouth or of parts lower down, in consequence of inhaling a hot blast or swallowing boiling water. In other cases the injury may originate within the body, as by calculi passing along tubes or lodged in cavities; hardened fæces in the intestines; parasites; or the rupture of enlarged veins, aneurisms, or abscesses opening into mucous cavities.

The effects of an injury to a mucous surface differ much in their nature and extent, according to its cause. Thus there may be a mere contusion; a superficial erosion or abrasion; a more or less extensive wound or rupture, other structures being then also involved; a burn or scald; or actual destruction by corrosives. More

or less inflammation follows injury to a mucous surface. Subsequently ulcers may be produced, which by their cicatrization may give rise to constriction or actual obliteration of tubes. and other untoward consequences.

2. **Hyperæmia and Anæmia.**—The mucous membranes are very prone to become the seat of congestion, either active, mechanical, or passive. *Active congestion* may be a part of a physiological process, as is seen in the gastric mucous membrane during the process of digestion. Any slight irritation may also cause it, and it is scarcely practicable to indicate a distinct line of demarcation between this condition and inflammation, of which active congestion constitutes the earliest stage. It is characterised by bright redness, new vessels frequently coming to view; and at first by a tendency to dryness of the affected membrane, which may be followed by excessive and altered secretion. *Mechanical congestion* is often an important morbid condition in connection with mucous structures, giving rise to troublesome symptoms. For instance, in cases of cardiac disease obstructing the pulmonary circulation, the mucous lining of the air-passages becomes more or less congested permanently; and if the general venous circulation becomes overloaded from a similar cause, other mucous tracts suffer, especially that of the alimentary canal. This tract is also directly involved in cases of portal obstruction. Particular portions of a mucous membrane might become the seat of mechanical congestion, if some local vein should become obstructed from any cause. The effects of this condition are in the first instance to make the colour deeper, with a more or less venous hue; and at last the small veins may be evidently dilated and varicose. The secretion becomes modified in quantity and quality, and in time a permanent discharge is likely to be established, consisting of an unhealthy, thick, and tenacious mucus; while the proper secretion of special glands, such as the gastric juice, is interfered with. In some instances mechanical congestion gives rise to an abundant flow of a watery mucus. The membrane itself is also liable to become altered, being swollen at first; and ultimately it may become permanently thickened and firmer than normal, owing to increase of connective tissue, while its own special structures degenerate. *Passive hyperæmia* may follow inflammation of a mucous membrane; or it occurs in persons of relaxed and feeble habit; or follows undue use of a part covered with a mucous membrane, as in the case of the throat.

*Anæmia* in connection with a mucous membrane is important only when this is a part of general anæmia from any cause. Those mucous surfaces which are visible, such as the conjunctivæ or the lining of the mouth and lips, give the most striking evidence of this condition, as indicated by their pallor or even bloodlessness. An anæmic condition of the alimentary canal interferes in an important degree with the functions of its mucous membrane, and with the formation of the secretions which it normally produces.

3. **Inflammation.**—Various forms and degrees of inflammation are of very common occurrence in connection with mucous membranes, and a large number of cases in ordinary practice belong to this class. Without entering into any description, it will suffice to state here that the inflammation may be acute, sub-acute, or chronic; and either catarrhal, croupous, or diphtheritic in character (*see* INFLAMMATION). Different tracts of membrane present different degrees of liability to these several forms of inflammation; and the catarrhal form not only has various grades of intensity, with corresponding variety in its products, which may become mucopurulent or actually purulent, but these products also differ in their nature in connection with different membranes of the mucous class. Further, inflammation from special causes, such as gonorrhœa, is characterised by running a definite course, and forming special products. When the inflammation is of a severe type, it may end in more or less destruction of the mucous tissues, as indicated by erosions, ulcerations, or even gangrene. Where the submucous tissue is loose, œdema is liable to occur. From this cause, as well as from thickening of the mucous membrane itself, or from a croupous or other deposit on its surface, narrowing or even actual closure of any tube or passage lined by such a membrane is apt to be produced. Inflammation may also give rise to sub-mucous suppuration. When the inflammation is chronic, permanent changes are set up in mucous tissues, the normal elements being altered or entirely removed, and a fibroid material being formed in course of time, so that the membrane is rendered permanently thickened and tough. The cause of inflammation of a mucous membrane may be *local*, including injury, mechanical or chemical irritation, or that resulting from undue heat or cold, morbid products or growths; or *general*, such as chilling of the body from 'a cold,' blood-poisoning in connection with fevers and other conditions; or the inflammation may be a part of some specific disease—for instance, diphtheria or gonorrhœa. Some mucous tracts are particularly liable to be affected under certain predisposing conditions, and at certain periods of life. Thus, bronchitis is very common in children and old persons; while the former are exceedingly subject to catarrh of the alimentary mucous lining.

4. **Ulceration.**—Ulcers are of common occurrence on mucous surfaces. They usually result from injury or inflammation, or are the termination of certain special morbid processes, as in the case of typhoid fever, syphilis, tubercular disease, cancer, dysentery, or diphtheria. Ulceration may depend upon destruction of the tissues by parasitic growths, as in some cases of thrush. Some pathologists believe that ulceration of a mucous membrane occasionally arises from plugging of arteries, and consequent death of a limited portion of this membrane, which separates, leaving an ulcer. In the case of the stomach it has also been supposed that under certain circumstances the gastric juice may so act upon the mucous lining as to destroy it. A peculiar form of ulcer is sometimes observed in the duodenum after severe burns. Ulceration often begins in connection with the glandular structures; this may be due in the first instance to mere blocking up of their orifices, leading to accumulation of their products and subsequent inflammation:

but certain special morbid processes commence in these structures. Inflammation may cause ulceration, either by directly destroying the membrane rapidly or gradually, or by setting up sub-mucous suppuration. Mucous ulcers differ much in their seat, extent, depth, shape, and other characters, according to their cause. The simple forms are either mere erosions, or of the catarrhal or follicular varieties; and in each of the special diseases already mentioned the ulcers present peculiar characters. Occasionally they assume a gangrenous appearance. If they extend deeply, they involve other tissues besides those of the mucous membrane, and may thus lead to perforation of cavities or tubes, and other untoward consequences. Cicatrization often takes place, and this may lead to permanent contraction, stricture, or even complete closure of channels lined by mucous membranes, with more or less thickening and induration. Ulceration frequently destroys the glandular structures, which are not afterwards renewed.

5. **Gangrene.**—Occasionally the tissues forming mucous membrane mortify, as the result either of severe injury, corrosion, inflammation, or vascular obstruction. The gangrene is of the moist kind, and the dead tissues may separate in a mass or in shreds. Consequently an ulcer is left; or actual perforation of a tube or hollow organ may take place.

6. **Nutritive Changes.**—*Hypertrophy* of mucous tissues is sometimes seen, but this may appear to be the case when it is not really so, the membrane being thickened and firm, owing to a chronic inflammation, and the formation of fibrous tissue. *Atrophy* is not uncommon, especially of certain of the elements of mucous membranes, such as the glands or epithelium. *Degeneration* is also often observed, affecting these and other structures. This degeneration may be of a senile character; or of a special kind, such as albuminoid or mucous degeneration. Not uncommonly mucous tissues are relaxed and deficient in tone, their nutrition being impaired.

7. **Deposits and New Growths.**—The chief new formations observed in connection with mucous membranes are polypi, villous growths, epithelioma, and tubercle. Syphilitic gummata may involve these membranes. Cysts also occasionally form, originating from the glands or epithelial structures. It may be mentioned here that certain animal or vegetable parasites are often associated with mucous membranes.

8. **Special Diseases.**—It will suffice to remark under this head that in certain diseases mucous membranes are particularly affected, such as typhoid fever, diphtheria, and dysentery.

Symptoms.—The symptoms which may arise in connection with one or other of the diseases affecting mucous membranes just indicated, are of the following nature:—

1. *Morbid sensations*, usually of a more or less painful character, are often experienced. These will vary in degree and kind, not only with the nature of the disease, but also with the particular mucous surface which is involved, some being much more sensitive than others. Painful sensations are chiefly met with in connection with injury, inflammation, or ulceration, and they will be localised in accordance with the seat and extent of the mischief. As a general rule it may be stated that the sensation is one of burning, rawness, or soreness; and it is usually much increased by any irritation of the affected part, to which mucous membranes, from their situation, are specially exposed. Sometimes the morbid sensation consists in a feeling of tickling, itching, or undue irritability and sensibility to sensory impressions. It must be borne in mind that serious lesions of mucous surfaces, which, as a rule, cause marked painful sensations, may exist without any such effects.

2. *Hæmorrhage* from mucous surfaces is of common occurrence, the amount of blood lost varying from a mere trace to a quantity sufficient to cause death. The bleeding may apparently take place quite spontaneously, and without any evident cause, as in some cases of epistaxis; or it may be associated with congestion, injury, inflammation, ulceration, gangrene, new growths, or other conditions.

3. *Morbid products* are very frequently formed on mucous surfaces, or the normal secretions are modified in quantity or quality. Thus, the mucus may be deficient or excessive; and either thin and watery, unduly thick and adhesive, modified in its reaction, or otherwise altered. A free serous flow may take place from a mucous membrane, as the result of congestion or catarrh. Muco-purulent matter, actual pus, and croupous or diphtheritic substance, are among the chief morbid products formed in connection with mucous surfaces. Not only do these materials reveal their presence by being discharged externally in various ways, but they may themselves cause other symptoms, by affecting substances with which they come into contact. For instance, in the alimentary canal unhealthy mucous secretions often lead to fermentation and decomposition of food, with their consequences; and similar effects are produced on the urine by morbid materials formed in the bladder. Some products are also in themselves irritating, and affect injuriously the surfaces over which they pass, causing pain, or setting up secondary inflammation. Gangrenous tissues may also be discharged.

4. *Expulsive actions* of different kinds are often excited by morbid conditions connected with mucous surfaces lining passages and organs. These may be illustrated by sneezing, coughing, vomiting, undue action of the bowels, and frequent micturition. They may result merely from excessive sensibility of the membrane; or from the presence of blood, or of the morbid materials already mentioned.

5. The *special functions* of certain mucous membranes are very liable to be interfered with when they are affected in various ways, especially in consequence of changes in the epithelium and glandular structures. This may be best illustrated by the alimentary canal, where dyspeptic symptoms often arise from changes of this character, the secretions necessary for the process of digestion not being properly formed; and absorption by the intestinal wall is also liable to be interfered with.

6. *Obstruction* or *contraction* of tubes or orifices lined by mucous membranes may arise from inflammatory or hypertrophic thickening, submucous œdema or suppuration, thick secre-

tion, cicatrization of ulcers, or some forms of new growth. The consequent symptoms are similar to those from other forms of obstruction, such as dysphagia when the œsophagus is affected, dilatation of the stomach from obstruction of the pylorus, retention of urine when the urethra is involved, or some form of dyspnœa when the air-tubes are obstructed.

7. *Physical examination*, particularly by *inspection*, at once reveals the condition of mucous surfaces which are visible. This may be aided by instruments in the examination of parts which are situated more internally. Special modes of examination give us important information as to the diseases of certain mucous membranes, such as that lining the air-tubes.

8. *General symptoms.*—Diseases of mucous membranes are often accompanied with symptoms affecting the general system. The most obvious of these are fever and wasting, which may arise from various causes. Pyrexia is not as a rule high in inflammation of mucous surfaces. It must be remembered that certain affections of this class of membranes are but manifestations of some general or constitutional disease, which presents its own symptoms.

Treatment.—The general principles or indications in the treatment of diseases of mucous membranes may be summed up as follows:—1. To relieve pain and other sensations by appropriate means. 2. To check hæmorrhages, if they are in such amount as to need interference. 3. To subdue inflammatory action. 4. To brace up and give tone to relaxed tissues. 5. To influence secretions and morbid products, increasing or diminishing the former, checking or modifying discharges, and endeavouring to affect special materials, such as diphtheritic deposits. 6. To allay undue excitability, causing violent actions; or to aid such actions as may be necessary to expel excessive secretions or morbid products; or in other ways to prevent their accumulation. 7. To supply the place of, and prevent the symptoms resulting from the want of secretions necessary for special purposes, which are formed by certain mucous surfaces, such as the gastric juice. 8. To treat particular morbid conditions, such as ulcers, gangrene, new growths, or constriction, with the view of curing them. 9. To treat general symptoms.

*Local* applications; or such remedies as when administered internally come into contact with the affected surface, are of much value in the treatment of diseased mucous membranes. These may be anodyne, sedative, stimulating, astringent, demulcent, or of other kinds, according to the action required; and they are often advantageously applied in special ways. Operative procedures are not unfrequently required. *General* treatment is often of the greatest service in the management of diseases of mucous membranes, and this may be the only indication needing attention. Moreover, it must be borne in mind that there are certain diseases in which the morbid condition of the mucous membrane is but a part of the general malady, and calls for no special treatment.

Frederick T. Roberts.

**MUCOUS RÂLE.**—An adventitious sound heard on auscultating the chest in certain forms of disease, and due to the passage of air through viscid fluid in the bronchi. *See* Physical Examination.

**MUCOUS SECRETION, Disorders of** *See* Mucous Membranes, Diseases of; and Secretions, Disorders of.

**MUCOUS TUBERCLES.**—Synon.: Condylomata; Fr. *Plaques muqueuses.*

Definition.—Flattened raised patches upon the soft skin and mucous surfaces of syphilitic persons. *See* Condyloma.

Ætiology.—Mucous tubercles are a certain evidence of syphilitic contamination, and belong to what are commonly known as the secondary manifestations; they may appear very early in that stage of the disease, or amongst the later symptoms. They are often present in hereditary syphilis. Mucous tubercles are much more frequent in women than in men; in fact they are sometimes the only symptom of the constitutional taint in females.

Experimental inoculation of the discharge from these tubercles shows that it is capable of producing a hard chancre at the point of insertion, followed by general syphilis; and from clinical observation it would appear that these lesions are highly contagious, and a fertile source for spreading disease.

Description.—Mucous tubercles consist of a circumscribed hypertrophy of the skin and cuticle. They appear as flat, elevated patches, of a round or oval shape, with a broad base, of a reddish colour, and generally covered by a thin grey pellicle. When in close proximity they coalesce, and form a dense tuberculated mass of irregular shape and size, which is generally fissured, ulcerated, and encrusted with dried secretion from the neighbouring skin. As a rule they are not painful, but when irritated they become very sensitive. When situated upon a mucous membrane they are less raised, patchy in appearance, and whitish in colour. This is especially the case in the throat, where they have been termed *plaques opalines.* At other times they may form superficial ulcerations with inflamed margins.

The favourite locality of mucous tubercles is the genital organs, the anus, and the moist skin adjoining; but they are not frequent on the penis. They may also be found at the umbilicus, axillæ, auditory meatus, alæ of the nose, on the lips and nipples, and between the toes. The mucous membranes usually affected are those of the mouth, tongue, and throat; and occasionally they are seen in the vagina or on the os uteri. Want of cleanliness favours their development, as does irritation from any cause; and in stout persons they may be met with in unusual situations, where folds of skin meet, and perspiration collects.

In young children, the subjects of inherited syphilis, mucous tubercles are generally found at or about the anus or organs of generation; but when the disease has been communicated, the mouth and fauces are more usually affected.

Treatment.—The local treatment of syphilitic condylomata is cleanliness, with some mercurial or astringent application; and if the patches be

small and few in number, this will generally be sufficient. If the tubercles be large, indurated, and ulcerated, or if they be very chronic, with little disposition to subside under the above treatment, an occasional pencilling with nitrate of silver or tincture of iodine may hasten their removal. General mercurial treatment must be combined with the local remedies. Attention must of course be given to the general health.

GEORGE G. GASCOYEN.

**MULTILOCULAR** (*multi*, many, and *loculi*, small spaces).—A term applied to cysts and other forms of growths, and to pulmonary cavities, when they consist of many small spaces or loculi. *See* CYSTS.

**MUMPS.**—SYNON.: Parotitis; *Cynanche Parotidea*; Fr. *Oreillon*; Ger. *Mumps*.

DEFINITION.—An acute, febrile, infectious disease; attended with swelling of the salivary glands, mostly of the parotids; and ending in resolution.

ÆTIOLOGY.—This is an affection more commonly seen in young persons—boys, growing girls, and young men; but it may occur in adults of either sex who are much with the sick, and have not had the complaint before. Mumps rarely attacks the same person twice. It occurs as an epidemic in large institutions, such as schools and barracks. It is conveyed from person to person by contagion—that is, by infecting particles reproduced in the course of the disease, and given off by the sick, possibly even before the glands are affected, certainly for two or three weeks afterwards. It has an incubation-period of from eight days to three weeks.

Some hygienic defects may favour the spread of mumps. Whether it prevails more at one season than another is uncertain.

ANATOMICAL CHARACTERS.—Not many, probably no cases of idiopathic parotitis afford the pathologist an opportunity of making a *post-mortem* examination into the nature of the affection. But arguing from analogy, some maintain that here, as in the more frequently fatal symptomatic parotitis, the inflammation has its starting-point in the gland-tissue proper, or in a catarrh of its duct. Others again assert, and this has long been the prevalent opinion, that the interstitial and the connective tissue around the gland are the seat of the mischief. The affection is probably both parenchymatous and interstitial. But wherever the inflammation has its origin, certain it is that the interstitial and cellular tissue around the gland are the parts which give most evidence of the existence of the disease. They become hyperæmic, infiltrated with serous fluid, and consequently much swollen. And this œdematous state passes to structures beyond those pertaining directly to the parotid gland. Seldom does there appear to be any fibrinous exudation poured out; and still less frequently do the tissues exhibit any tendency to break down and to suppurate. The swelling completely disappears about three days after the fever. On the subsidence of the local lesion a so-called metastasis to the testicle and other glandular and fibrous structures is not rare. Alterations in the kidney and atrophy of the testicles have followed; nor have the investments of the nerves, or the surfaces of the heart, always escaped.

SYMPTOMS AND DIAGNOSIS.—Some general symptoms always precede the local manifestations of mumps; they may be so slight as almost to escape notice; or fatigue in the day, restlessness at night, chilliness, or vomiting may mark the ingress. These initial symptoms do not occur until a week after exposure to infection, and may not be followed at once by the local signs. Mostly, after a week of malaise, or only a look of illness, the onset of mumps is sudden, with chill, rarely rigor, sometimes vomiting, and well-marked fever; often only a few hours before pain and swelling begin in the parotid or sub-maxillary glands.

One restless night follows, either from pain, or from fever, or both. Sometimes the pain is severe, and the temperature only elevated by one degree; sometimes the fever is more evident. It generally reaches 100° or 101°, and frequently rises to 103° or 104°; at this point it is not long maintained, but subsides as the local lesion is established, falling to the normal, or even below it, on the third or fourth day of the disease. The temperature may be low while the swelling is still marked and painful; and in some cases appetite returns before eating is easy. This happens when the patient is kept at rest in bed. Without such precaution sudden and great elevations of temperature occur at the end of the first week, either without serious local mischief, or with orchitis, deafness, tinnitus of one ear, and albuminuria, not always transient; rheumatism, and heart-affections, leaving traces both of pericardial and of endocardial inflammation, may also occur.

From face-ache and enlarged lymphatic glands, the sudden sensation of pain or stiffness in the parotid or submaxillary gland, following on the general symptoms, and absence of any such local trouble as usually affects the lymphatics, together with the history of a possible infection, will generally suffice for the diagnosis of mumps. Further evidence is obtained on examining the spot, where, besides the swelling being at first deeply seated, some degree of swelling of the parts surrounding the gland exists near the lobe of the ear, which very soon thereafter increases to such an extent as to involve more or less the whole of one side of the face, and passes down on to the neck. Coincidently with the appearance of this enlargement, the pyrexia declines in some cases; while in others some days elapse before the subsidence of the fever. Pain is now complained of, and the patient can no longer open his mouth to the usual extent. Yawning excites severe pain; in fact, it can hardly be effected. The yawn is aborted. So with mastication and speaking—they are greatly impaired, and the sufferer prefers to starve and to remain silent rather than endure the pain involved in the effort to perform either act. The saliva is either largely increased, going the length of salivation, or much diminished in quantity. If pressure be made over the swelling, the patient quickly indicates the unpleasantness and the pain of the proceeding; and the sensation afforded by manipulation is that of an elastic tumour, with a slightly softer feeling in the centre. The skin

over the swelling may be slightly reddened; often there is no deviation from the normal colour. In many cases these symptoms are not nearly so severe, and the disproportion between the amount of distortion of the countenance and the actual suffering is sufficiently astonishing, as well to the patient as to the sympathising friends. Most frequently the affection is limited to one side of the face; but as the swelling of the one side subsides, the other seems to take it up, and it runs through the same series of events, with, possibly, an interval of a few days between them. Rarely are the two sides simultaneously affected; but in such a case the uneasiness, pain, and discomfort are of course greatly increased. After the continuance of these symptoms for about six or eight days, they begin to abate, the œdema lessens, the pain is lost, the stiffness and tension disappear, and in a few days later the face acquires its usual appearance. Occasionally there is left, for some time after this, a certain degree of hardness in the neighbourhood of the parotid, which gives no uneasiness, and can rarely be mistaken for tumour. In like manner the history of the case will disclose the nature of other local pains, or of orchitis.

Not uncommonly, especially in young subjects, a 'metastasis' takes place from the parotid gland to the testicle in boys, and to the mammæ or ovary in girls. When this occurs, and it may happen at any period of the disease, an exacerbation of the fever takes place, and at the same time pain in the inguinal region is complained of. An examination of the parts reveals the fact that there is swelling of the testicle, an orchitis, as well as an accompanying œdema of the scrotum. In the case of the girl the vulva becomes the seat of the œdema, and on pressure over the region of the ovary pain is elicited. The metastasis may take place before the inflammation of the parotid has entirely subsided; and when the orchitis abates, the parotid may again take on the inflammatory condition. Inflammation of the coverings of the brain is to be feared on sudden subsidence of the inflammation of the parotid, if no orchitis follows the disappearance of the original affection.

Prognosis.—This is almost invariably favourable in mumps, unless in the very weakly and in the tuberculous, or in the rare event of meningitis being developed. It may be said to be always a disease of a comparatively trivial nature, producing considerable pain and much discomfort, but not endangering the life of the sufferer. In very exceptional instances the inflammation of the parotid terminates in abscess. The indications of such an untoward result are increased pain in the centre of the swelling, hardness, and dark red appearance of the skin over the spot. In time the abscess discharges outwardly, or into the external auditory meatus. Atrophy of the testis sometimes follows 'metastatic' orchitis.

Treatment.—It may not, in every case, and at all seasons, be necessary to confine a patient suffering from mumps to his bed. But little treatment, beyond rest and care for the week or ten days this disease lasts, is required; still it is more prudent for the first few days to enjoin rest in bed. This is particularly necessary if the patient be young. In every case going out into the open air should be forbidden, and the patient recommended to keep as much as possible to one room. Rise of temperature means increased waste, and this is cancelled by rest. The bowels may require relief, as constipation keeps up disturbance of the temperature. All active evacuants should be avoided. It may be well to give some simple saline, as potash with lemon juice, and diluents during the first few days; ice is always grateful. A dose of chloral may be required at night (a grain for each year of the patient's age in children) if there be any restlessness.

As to local treatment, not much is required, unless the pain be unusually severe. It will be sufficient in most cases to protect the part from the air by means of a light handkerchief. Should more active interference be called for, some anodyne may be used, or soothing embrocation, such as the soap and opium liniment, belladonna liniment, or external warmth; discretion in the use of these may safely enough be left in the hands of the patient himself, if of mature years. If there be the slightest tendency to suppuration, indicated by increase of fever and tenderness over the gland, with redness of the overlying skin, poultices must be had recourse to, and so soon as distinct fluctuation is discovered the abscess must be opened, otherwise the gland-tissue becomes still further disorganised, the lobules become softened and break down, and the gland is permanently destroyed. The application of leeches is useless in reducing the inflammation, or in staying the formation of the abscess. They may be of service in lessening the pain of metastatic orchitis or ovaritis; but these are well treated by the same gentle means employed in the case of the parotid itself. It is almost universally recommended in the case of a metastasis to try to induce a return of the inflammation to its original source, by the application of irritants to the parotid, such as a mustard poultice. This seems unnecessary in the majority of instances, as the inflammation is of such a mild type; besides it implies a belief in the dictum that this is a true metastasis, and not merely another manifestation of the same morbid condition which originally gave rise to the parotitis. Tepid sponging is of use during the course of the disease, and a warm bath, or a pediluvium, may be required when metastasis threatens. Sometimes wine or brandy is required.

Considerable anæmia and much debility may persist even when mumps has been mild in its course, especially in the weakly or unhealthy, so that tonics, with iron and cod-liver oil, may have to be continued for some time.

C. Muirhead.

**MURMUR.**—This term, as used in auscultation, was originally applied to the natural sounds heard over the lungs in respiration; but its employment has since been extended to include a great variety of auscultatory sounds connected with the heart, the blood-vessels, the placenta, &c. *See* Physical Examination.

**MUSCÆ VOLITANTES** (*musca*, a fly; *volitans*, floating about).—This name is given to the semi-translucent threads, spots, circles, and filaments that may be seen, subjectively, to float and glide about over the field of vision. They

form the spectrum of the vitreous humour, and may be seen by every eye. They are stirred up and brought into view whenever the eye is suddenly moved; and when the eye is fixed they continue to float about for a time, then gradually subside, and seem to sink down below and away from the axis of vision. True *muscæ volitantes* have no pathological significance, and are not visible objectively. They are, however, not unfrequently associated with some error of refraction, or with disturbed states of cerebral circulation. *See* Vision, Disorders of.

**MUSCLES, Diseases of.** — Synon.: Fr. *Maladies des Muscles*; Ger. *Krankheiten der Muskel.*

In describing the diseases of the muscular tissue attention will be confined to the voluntary muscles, excluding diseases of the muscular substance of the heart, which are treated of elsewhere. Many of the morbid states of the voluntary muscles come properly under the consideration of the surgeon, and others of them will be more suitably treated of in special articles on the various diseases of the nervous system with which they are associated. There still remain, however, some special diseases of muscles to be described.

1. **Acute Inflammation.** — Synon.: Myositis.—Ordinary inflammation of muscle, leading to exudation and suppuration, arises chiefly as a result of injury, rupture of a muscle, or extension of inflammation from neighbouring diseased bones. Inflammation sometimes, however, arises spontaneously, particularly in the tongue, diaphragm, and psoas muscle; in the latter situation forming one variety of psoas abscess. The symptoms are pain, tenderness, and swelling, corresponding to the seat of the inflammation. Exudation of serum and of lymph takes place, and subsequently an abscess may form; occasionally the process goes on to gangrene.

Secondary inflammations and formations of pus are of more frequent occurrence than simple inflammation and abscess. They arise in the course of the various forms of pyæmia. The presence of such secondary abscesses in muscles is especially characteristic of glanders and farcy, where inflammatory infiltrations of various sizes appear in many of the muscles, especially those of the arm. Disintegration takes place in their centre, and a collection of puriform fluid results.

2. **Chronic Indurating Inflammation.**—In this form of inflammation there is proliferation of cells in the interstitial tissue, causing the muscle to become hard and painful. The whole muscle may be attacked, or the process may be limited to one or more portions. Infants are often attacked by chronic inflammation of the sterno-mastoid muscle. The whole muscle becomes hard and painful, but rarely suppurates. The disease usually yields to soothing external applications; but if it be of syphilitic origin, the use of internal antisyphilitic remedies may be required. In adults chronic indurative myositis of a syphilitic character may occur in the sterno-mastoid, the various muscles of the leg and arm, the temporal and masseter muscles, the tongue, and other parts. The disease may appear either as a diffuse inflammation, with the usual signs of pain on movement, tenderness, and some swelling, or sometimes a series of beaded swellings; or as a circumscribed inflammation, with an abundant infiltration of nucleated cells. If the inflammation does not soon subside, the cellular exudation becomes organised into contracting fibrous tissue, and the compressed muscular fibres atrophy. In diffused myositis permanent contraction of the muscle may result from this cause; in circumscribed syphilitic myositis a fibrous tumour in the interior of the muscle may result; sometimes a gummy tumour is formed. Syphilitic tumours thus formed in muscle bear a great resemblance to malignant tumours. Indeed it is often found that the only means of distinguishing the two clinically is by the effect of iodide of potassium in causing the disappearance of the former.

3. **Rheumatic Inflammation.**—The morbid changes in this form of inflammation rarely pass beyond the stage of congestion and serous exudation, though occasionally proliferation of the interstitial tissue may occur, and callosities may be formed. *See* Rheumatism, Muscular.

4. **Hæmorrhage.**—Hæmorrhage takes place in muscle not only from injury, but frequently in the course of typhus and typhoid fevers and pyæmia.

5. **Rupture.**—Rupture of muscle is a subject which falls more properly into the domain of the surgeon, but the accident occurs also in circumstances which may bring it under the notice of the physician. Violent contraction of a muscle, without external injury, may lead to partial rupture of its fibres, for example the gastrocnemius. The violent spasms of tetanus occasionally cause complete rupture of a muscle, particularly of the muscles of the back, the rectus femoris, and the psoas. Rupture of muscles has been known to occur in the delirium of fever; and may be the cause of abscess forming in muscle, as described above.

Treatment. — The treatment of ruptured muscle consists mainly in rest; in the support of the muscle by uniform bandaging; and in suitable applications, should the formation of abscess occur.

6. **Lesions of Sensibility.**—*a. Myalgia.*—This term was given by the late Dr. Inman to a painful condition of the muscles arising in those who are in feeble health. The pain is similar to that which is present in a muscle after long-continued and fatiguing exertion—for example, in the limbs after a long walk, or in the diaphragm and intercostals after violent laughing. In persons who are debilitated, pain may arise in the muscles after very slight exertion, and this constitutes myalgia. It is often accompanied by cramps at intervals. The pain is most commonly felt at the tendinous insertion of the muscle. The abdominal muscles are frequently the seat of myalgia, such as the costal origin of the external oblique—causing, according to some authorities, that pain in the side which is so common in women—and the pubic insertion of the recti. The muscles of the back, and especially the trapezius, also suffer; the muscles of the limbs much less frequently.

When situated in the trunk, myalgia is often mistaken for some congestive or inflammatory condition of the liver, spleen, or other viscus lying beneath. The pains of myalgia are distinguished by their hot and burning character. They are increased by exercise of the affected muscle, and disappear when it is relaxed or artificially supported. However severe the pain may be, the pulse remains unaffected; but it is usually uniformly weak and fast.

The muscles or their fibrous connexions are also the seat of pain in the condition known as muscular rheumatism.

Treatment.—The muscles should have rest and support by bandaging. Tonic treatment is required. Dr. Inman especially recommended cod-liver oil and tincture of perchloride of iron. Friction and counter-irritation do little good. Exercise is of no use, unless combined with fresh air and good diet.

*b. Muscular anæsthesia.*—This term is given by Dr. Russell Reynolds to a group of symptoms occasionally met with, and believed by him to be caused by loss of the 'muscular sense.' See Muscular Sense, Disorders of.

7. **Atrophy and Degenerations.**—*a. Simple atrophy.*—Simple atrophy of the substance of muscular fibres arises either from general defective nutrition, during the course of wasting diseases, such as phthisis, in cachectic conditions, or after severe fevers; or as a local condition from disuse of the muscle. The muscles become pale and flabby. The ultimate fibres are reduced in volume, but preserve their anatomical characters, still showing the longitudinal and transverse striation. The atrophy is sometimes so advanced in parts, that the muscular substance of the fibre entirely disappears, and nothing is left but the sheath of the sarcolemma, which appears in the form of fibrous bands between the remaining muscular fibres.

As a local condition, atrophy is most frequently seen in muscles in the neighbourhood of a diseased joint, or in a paralysed limb. In these cases the atrophy is usually combined with more or less interstitial deposit of fat between the ultimate fibres, constituting *fatty growth* on or *infiltration* of muscle. Occasionally the amount of fat is so great as to cause an actual increase in bulk of the muscle, so that it appears hypertrophied. The atrophic and other changes arising in paralysed muscles are considered in their appropriate articles. Fatty infiltration of muscles may also arise as a primary condition, when there is an excess of fat in the blood, and atrophy of the muscular substance results from it.

*b. Fatty degeneration.*—Here the fat is deposited, not between the ultimate fibres, as in fatty infiltration of muscle, but in their interior. Rows of minute granules appear in the longitudinal striæ, and gradually increase until the whole breadth of the fibre is occupied by them, and nothing is left but the sarcolemma. When the degeneration reaches this extent, it is of course irrecoverable. Muscles affected by this change become very soft and friable. This degeneration is met with much oftener in the heart than in voluntary muscles. It is sometimes associated with atrophy of the fibres in the muscles of limbs attacked by certain forms of paralysis. It is met with also in fever and phosphorus-poisoning, granular degeneration being the first stage. *See* Fatty Degeneration.

*c. Granular degeneration.*—Granular degeneration of muscles occurs in fevers and acute diseases. The ultimate fibres become swollen and opaque, being filled with fine granules. These clear up on the addition of acetic acid; this test distinguishing granular from fatty degeneration. The muscles which are affected by it are soft and friable and easily rupture. The fibres no doubt ultimately recover their natural appearances; but if the disease be severe and long-continued, granular degeneration advances to fatty degeneration, as is seen in cases of phosphorus-poisoning.

*d. Waxy degeneration*; *Vitreous degeneration*; *Myositis typhosa.*—This degeneration, which was discovered by Zenker, is believed to be partly a *post-mortem* change. The affected fibres swell and lose their striation; and become of a homogeneous translucent aspect. After a time transverse fractures appear in each fibre, dividing it into a series of short cylinders. The nuclei of the sarcolemma also multiply. The change does not attack all the muscular fibres of a part uniformly; for healthy and degenerated fibres are seen side by side. It is observed chiefly in typhoid fever, cholera, and other acute febrile diseases, being often associated with the granular degeneration. It usually attacks the adductor muscles of the thigh, the abdominal and pectoral muscles, and the diaphragm; appearing in patches of one or more square inches, which gradually become softened and pulpy, and resemble a muscular abscess (Wilks and Moxon). *See* Degeneration.

*e. Fibroid degeneration.*—Fibroid degeneration of muscle has already been referred to as a result of myositis. Chronic or repeated inflammation, of a rheumatic or syphilitic character, leads to the formation of fibrous tissue in muscle, and the muscle becomes of a tough whitish character.

*f. Ossification.* — Ossification of muscle is a rare result of chronic inflammation or irritation. It is observed to occur in muscles which are subject to pressure, as the deltoid in soldiers, and the adductors in riders. In a few cases ossification of a considerable number of the muscles has taken place.

8. **Tumours.**—Besides the syphilitic, fibrous, and gummatous tumours already referred to, muscle is subject to growths of a sarcomatous and cancerous nature. Fatty, cartilaginous, vascular, and other tumours, are also met with in this tissue, but rarely.

9. **Parasitic Affections.**—The chief disease of muscles belonging to this group is that due to the presence of *trichinæ* (*see* Trichinosis). The *cysticercus cellulosæ* is also sometimes found in muscles. *See* also Pelodera.

Alexander Davidson.

**MUSCULAR ATROPHY, PROGRESSIVE.** *See* Progressive Muscular Atrophy

**MUSCULAR HYPERTROPHY.** — An increase in muscular tissue, affecting either the voluntary muscles, or the muscular tissue of special organs, such as the heart, the intestine, or the bladder. True muscular hypertrophy must

not be confounded with an increase in the volume of muscular structures from hyperplasia of the connective-tissue elements. *See* HYPERTROPHY; and PSEUDO-HYPERTROPHIC PARALYSIS.

**MUSCULAR RHEUMATISM.**—A form of rheumatism affecting the muscles. *See* RHEUMATISM, Muscular.

**MUSCULAR SENSE, Disorders of.**—By the term 'muscular sense' is meant the sensation by which we are aware of the degree of force exerted by contracting muscles. By it we become conscious of the resistance to contraction, that is, the tension of the fibres, rather than of the contraction itself. This sense must be distinguished from the 'common sensibility' which muscles possess, and by which we feel—(1) pain on firm pressure; and (2) pain on tetanic contraction, whether spontaneous ('cramp'), or excited by faradisation, independently of the excitation of cutaneous nerves, as when the skin is insensitive or absent. It must also be distinguished from (3) the sense of muscular fatigue. The muscular sense proper has been referred to a sensation in the joints, skin, and other parts, of the position of the limb, but it may be unimpaired when this sensation is lost (*see* KINÆSTHESIS). It has been thought to be merely the consciousness of the degree of the out-going motor-impulse, but it may be lost when motor power is normal, as in a case under the observation of the writer, in which the muscular sense was suddenly lost in one arm, although the power was unimpaired. A poker did not seem heavier than a feather. The sensibility probably depends upon afferent fibres, which have been found by Tschirjew to terminate between the fibrillæ. They apparently course with the motor fibres in the mixed nerves, but pass to the spinal cord in the posterior roots. From the fact that the common and special sensibility of muscles may be lost in different degrees, it has been conjectured that in the cord the paths are not quite the same.

**Hyperæsthesia.**—Increase of the common sensibility of muscles is not unusual, but very little is known of that of the muscular sense. The sensation of restlessness, impelling movement, has been attributed to it, but without sufficient reason. An increase of the muscular sense has also been supposed to exist in writer's cramp and chorea (Eulenberg).

**Anæsthesia.**—Diminution of common sensation in muscles is frequent, with or without loss of voluntary power. Diminution of the special sensibility, *muscular anæsthesia*, or *muscular analgesia*, is occasionally observed, commonly in consequence of central disease, especially of the spinal cord, and is usually associated with a diminution of other forms of sensibility. The diseases in which muscular anæsthesia is commonly observed are locomotor ataxy and hysteria. In the former it is common, but not invariable, and bears no necessary relation to the change in cutaneous sensibility.

SYMPTOMS.—In muscular anæsthesia the patient is unaware of the degree of force exerted by the contracting muscles, and is dependent for his knowledge of the position of his limb, and of its movements, mainly upon cutaneous impressions. Ignorance of the degree of contraction interferes with muscular coördination, by rendering this dependent on cutaneous and ocular perceptions. When these are perfect, the amount of incoördination may be slight. The condition of the muscular sense is ascertained by observing the accuracy of movement with and without closure of the eyes, and especially by ascertaining the sensitiveness to movement against resistance so applied as to affect the cutaneous nerves as little as possible. The best method for this purpose is to suspend a weight, in a bag or cloth, to the limb, and observe (*a*) the minimum which can be recognised; and (*b*) the least increase in a greater weight which can be distinctly perceived. The sensibility of the two limbs may be conveniently compared. In each of these points the muscular sense may present a deviation from the normal, and the change in the two is not always proportioned. The minimum recognisable, and the minimum difference recognisable, vary in different parts. The latter amounts in the case of the arm in health to a difference of $\frac{1}{40}$th in a weight of three or four pounds. Balls of similar size and appearance, but of different weights, have been employed for the same purpose.

TREATMENT. — Muscular anæsthesia usually occurs as part of a wider affection, as in hysteria and ataxy, and rarely requires special treatment. Sudden local loss of muscular sense commonly depends on an acute, localised change in the cord, and requires rest and counter-irritation. In one case under the writer's care, such a condition in the arm rapidly passed away under this treatment. Faradisation of the muscles has been suggested, and may in some cases be useful.

W. R. GOWERS.

**MUSCULAR SPASM.** *See* SPASM.

**MUSCULAR TIC.**—A synonym for facial spasm. *See* FACIAL SPASM.

**MUSCULAR TREMORS.** *See* TREMORS.

**MUSHROOMS, Poisoning by.**—SYNON.: Fr. *Empoisonnement par les Champignons*; Ger. *Pilzvergiftung*.

Poisoning by mushrooms is by no means a common occurrence. Great discrepancy of opinion has existed as to the poisonous or harmless nature of some species of fungi. We are now, however, increasing our hitherto limited knowledge of the various species and varieties of mushrooms; and within the last dozen years the researches of Schmiedeberg, Poppe, and others, have thrown great light upon the active principle of at least one mushroom—the fly-fungus. The varied toxic symptoms produced by the ingestion of mushrooms become more easily explicable when we bear in mind that only a few fungi are apparently poisonous under all conditions. They are *Amanita muscaria*, the fly-fungus, which grows not very plentifully in this country; *Russula integra* seu *emetica* (*Agaricus integer* seu *emeticus*), also not very common; *Boletus luridus* (*B. perniciosus*, *B. bovinus*); and *Amanita phalloides* (*A. bulbusos*, *A. venenosa*, *A. viridis*), to which belong the varieties termed *Agaricus citrinus* and *Agaricus virescens*. Other fungi are poisonous only under special conditions, among which may be named

idiosyncrasy, and the susceptibility of young children to the toxic effects of mushrooms. The delicious edible morel even has been known to produce fatal results. It must not be forgotten that gastro-intestinal catarrh of a severe character may result from the ingestion of a large quantity of ill-cooked indigestible fungus-tissue; that the highly nitrogenous tissue of fungi is peculiarly prone to rapid decomposition; and that fungi as a class absorb excretory animal matters, perhaps unchanged. These circumstances may serve to explain some of the apparent anomalies connected with mushroom-poisoning. Some kinds of poisonous mushrooms have their active principle either dissipated or destroyed by the prolonged heat employed in thorough cooking.

Anatomical Characters.—Evidence of gastro-intestinal catarrh, more prominent in the stomach than in the intestines; signs of cardiac paralysis, or of asphyxia; occasionally fatty degeneration of the liver and other viscera; and minute sub-serous extravasations of blood, have all been noted after death from mushroom-poisoning.

Symptoms.—The symptoms of mushroom poisoning are of a twofold character: gastro-intestinal irritation, and a so-called narcosis. After partaking of a meal of poisonous mushrooms, colic sets in, followed by nausea and repeated vomiting, and diarrhœa eventually supervenes. The onset of symptoms does not as a rule manifest itself till after the lapse of some hours, six or eight or more, after partaking of the fungi. But this period is liable to great variation, and may be much shorter. Fragments of the fungi may be recognised in the fæces; and, indeed, were it not for this, and the history of the case, a diagnosis from violent ordinary gastro-intestinal catarrh would often be impossible. In severe and fatal cases the stools of the patient may become rice-watery in character; the patient becomes algid, collapsed, and cyanosed, with muscular contractions; and in children convulsions are not rarely met with. The sufferer eventually becomes somnolent and falls into a state of sopor; but this is perhaps not due to a true narcosis, but to the drain of fluid from the system, and carbonic acid poisoning.

When the *amanita muscaria* has been taken, cerebral symptoms are more prominent. The patient appears to be in a state of inebriation; and there frequently appears to be a tendency to dash the head against a wall or other solid object. These symptoms, are, however, not exclusively met with in muscarine poisoning, but may be observed when other fungi have been eaten.

Diagnosis.—The history of the case, and the detection of particles of the fungi in the fæces, are usually sufficient; but in the absence of these a diagnosis from natural disease is perhaps impossible. It has been proposed to test for the presence of muscarine, the active alkaloid of the fly-fungus, by applying a drop of the concentrated or unconcentrated urine to the heart of a frog. Muscarine causes the heart of the animal to stop in the state of diastole.

Prognosis.—The patient cannot be considered safe for at least three days, unless the more prominent symptoms have been markedly alleviated. Death may occur at any period between six and seventy-two hours. Recovery is frequent.

Treatment. — In poisoning by mushrooms emetics should be promptly administered, to evacuate the stomach, and those which are not of a depressing nature should be selected. The stomach-pump is perhaps of little service, seeing how persistently the particles of fungi adhere to the walls of the gastro-intestinal canal. Oleaginous purgatives, as, for example, a spoonful of castor oil in olive oil, may be advantageously administered. Fortunately the action of *muscarine*, which Schmiedeberg and Poppe have isolated as the active alkaloid of *amanita muscarina*, and which is probably identical with *bulbosine*, stated by Letellier and Speneux to be the active principle of *amanita phalloides*, is pretty well known. *Amanitine*, an alkaloid, is said to be an active principle in certain fungi, and is perhaps closely allied to muscarine. Atropine appears to be a direct antidote to muscarine; and digitalis appears to be so in a lesser degree. Atropine should therefore be given in small doses in cases of poisoning by *amanita muscarina*; and failing this some preparation of digitalis. Should atropine be administered it would be well to avoid the use of opium; but if atropine be not administered the exhaustive diarrhœa may have to be combated by the use of opiates combined with astringents.

Thomas Stevenson.

**MYALGIA** (*μῦς*, a muscle, and *ἄλγος*, pain). A name for pain in a muscle. *See* Muscles, Diseases of; and Rheumatism, Muscular.

**MYCETOMA** (*μύκης*, a mushroom). — A synonym for fungus-foot of India. *See* Fungus-Disease of India.

**MYCODERMA** (*μύκης*, a mushroom, and *δέρμα*, the skin).—Vegetable organisms associated with certain diseases of the skin. *See* Epiphytic Skin-diseases; and Tinea.

**MYDRIASIS** (*μυδρίᾱσις*).—This word was used by Galen and other writers to signify an undue enlargement of the pupil; but by Aretæus (*περὶ χρονίων παθῶν*, I. 7) to mean a shrinking or contraction of the pupil. Aretæus employs the word *πλἄτῦκορία* (ibid.) to express dilatation of the pupil. The word is now invariably used to mean a preternatural dilatation, and sluggishness or immobility of the pupil. It is the opposite of myosis. *See* Pupil, Disorders of.

**MYELITIS** (*μυελὸς*, marrow).—Inflammation of the spinal cord. A term that has been much abused, and which is still wrongly applied to many mere degenerative softenings of this organ. *See* Spinal Cord, Diseases of.

**MYELOID** } (*μυελὸς*, the marrow). — A
**MYELOMA** } form of sarcoma, characterised by the presence of giant or myeloid cells. *See* Tumours.

**MYOCARDITIS** (*μῦς*, a muscle, and *καρδία*, the heart).—Inflammation of the walls of the heart. *See* Heart, Inflammation of.

**MYOPIA** (*μύωψ*; from *μύω*, I close or blink, and *ὤψ*, the eye).—That form of *ametropia*, or error of refraction, in which, owing to a high refractive index of the dioptric media, or excessive convexity of the refracting surfaces, or abnormal elongation of the antero-posterior axis of the eyeball, parallel rays of light converge to a focus in front of the retina, and form, therefore, circles of diffusion upon the retina. It is the opposite of hypermetropia (*see* Hypermetropia), and is sometimes called *brachymetropia* (*βρᾰχύς*, short; *μέτρον*, a measure; and *ὤψ*, the eye), or *hypometropia* (*ὑπομετρος*, below the measure). *See* Vision, Disorders of.

**MYOSIS** (*μύω*, I shut).—A preternatural contraction and sluggishness or immobility of the pupil. The opposite of mydriasis. *See* Pupil, Disorders of.

**MYOSITIS** (*μῦς*, a muscle).—Inflammation of a muscle. *See* Muscles, Diseases of.

**MYXŒDEMA** (*μύξα*, mucus, and *οἴδημα*, a swelling).

Definition.—A name given by the writer of this article to a progressive disease, in which the tissues of the body are invaded by a jelly-like mucus-yielding dropsy, unaccompanied by albuminuria or other signs of primary affection of the kidneys.

Ætiology. — Beyond the almost invariable association of this disease with the period of adult life in women, no indications of its mode of causation have been recognised. In the fifteen or sixteen cases so far fully recorded, alcoholism, syphilis, and fevers, are, as causes, excluded by the history. More married than single women are affected. Pregnancy has in one or two cases been followed by the first appearance of the change.

Anatomical Characters.—Hitherto only two bodies of persons dying from this disease have been examined. The results were identical in these two. A remarkable overgrowth, associated with a sort of retrograde degeneration, of connective tissue was found in all parts of the body. The fibrillar element of ordinary connective tissue was everywhere increased, and its elements unnaturally defined; the corpuscular elements were enlarged and multiplied; the interstitial cement enormously augmented. In normal tissue this latter element yields some mucin. The skin in myxœdema yields many hundreds of times as much mucin as ordinary or anasarcous skin.

To such amplification and mucous infiltration the skin owes its swelling, its translucency, and its defect of secretion. The same sort of interstitial expansion is found in the mucous membranes, in glands of all kinds, in muscles, and in the central ganglia of the nervous system, subjecting the proper structural elements of each tissue to destructive pressure. It is most developed of all, perhaps, in the outer coat of arteries. The diminution of the thyroid is associated with an almost complete annihilation of the proper gland-structure by this stuff; and the late occurrence of albuminuria marks the advanced progress of its inroads on the Malpighian bodies and tubules. Whether the mental failure of the last stage be due to the operation of similar changes in the brain, is not a matter upon which a decision is at present possible. There appears to be a general increase of neuroglia, and a very considerable development of the connective tissue around all the vessels. On the other hand, the appearances seen in sections of the central ganglia are not those of disseminated sclerosis.

Symptoms.—The subjects of myxœdema are, some doubtful cases excepted, always adult females, who present a very characteristic physiognomy. The face is swollen in every feature, so as to suggest the existence of renal disease. But while the negative results of a complete examination dispel this idea, the distribution and quality of the swelling are different from what is observed in common dropsy. The swollen skin is singularly waxy-looking and anæmic; and the swelling affects dependent and non-dependent features equally. Thus the upper and lower eyelids, and the upper and lower lips are uniformly enlarged; the alæ nasi are thickened and broadened; the ridges of expression are blurred and coarsened, or the lines obliterated. The œdema is resilient; does not pit on pressure; and shows, as the foregoing statement indicates, no tendency to shift by gravitation. The cheeks are overspread with a dull pink flush, abruptly limited towards the orbits, and standing in vivid contrast with the anæmic skin around.

The conditions observed in the face prevail throughout the body. The skin is everywhere thickened, translucent, dry, and rough to the touch; perspiration being infrequent or absent. The hands, in particular, lose all shapeliness and expression, and have received from Sir William Gull the appropriate epithet, 'spade-like.' All visible and tangible mucous membrane is similarly amplified. Late in the disease ordinary anasarca is often added to the mucoid œdema.

Two other noteworthy phenomena are met with in the external examination of the body; first, a diminution, sometimes almost a disappearance, of the thyroid body; and secondly, a correlated tumefaction, with marked resilience of the skin, in the lower triangle of the neck, above the clavicle.

An affection of the nervous system as well marked as that of the skin, belongs to myxœdema. In the earlier stages an ever-increasing hebetude involves sensation, voluntary movement, and intellect; in the later, aberration of mind often supervenes. The face wears a fixed, heavy, and withal most sad expression; the speech is slow and laboured, though not slurred or slovenly; the voice monotonous, like that of an automaton, and leathery in tone. Sensation is slow, but finally sure. The movements of the limbs are slow and languid; the maintenance of fixed attitudes requires much effort; and sudden falls are not infrequent. It appears as if the muscles were toneless and excessively relaxed during rest, so that a considerable initial contraction is necessary before they bear on their attachments; and as if the muscular sense were also torpid. The result is that while there is neither jerking nor tremor of the legs in walking, the balance of the body is painfully maintained, as the weight is thrown on each leg in succession; and a quiver often runs through the body at the moment of raising one foot from the ground and balancing the body on

the other. This tardiness of coördination is altogether different from the vague staggerings and jerks of locomotor ataxy, and from the rhythmical tremors of disseminated sclerosis. And it must be remembered that there is no real loss of muscular power, no wasting of muscles, and no loss of sensation. Laxity of muscles at rest gives rise to drooping of the head on the chest in some cases; in others it has led to fracture of the patella, by allowing, first, a yielding of the extensors of the leg, and then a sudden arrest of the consequent fall.

In the operations of the intellect, thought and volition are again slow. All the patients observed have complained of being unable to perform any of the daily actions of life with their natural expedition. Yet all that they actually do is well done, and they are acutely conscious of their shortcoming in activity. In conversation ideas come deliberately, and are tardily expressed. To write a letter occupies an hour where it would before have taken ten minutes. Yet the language is correct, and the caligraphy unchanged. There is, in fact, an unwieldy state of mind as of body. The difficulty of collecting thoughts gives an early impression of loss of memory. This, in fact, occurs late in the disease, when other aberrations are developed.

Two affections of the special senses apparently related with changes of the periphery are often noticed—one a persistent unpleasant taste, sometimes of bitterness, sometimes of sweetness, &c.; the other a persistent unpleasant smell. Otherwise the special senses show no defect save tardiness. The hair is often scanty, and the teeth decay early—conditions no doubt related with the changes in the skin and mucous membrane.

The heat of the body is almost always lower than normal, ranging between 98° and 94° Fahr., or even less. Most patients complain of constant chilliness, without appearing to estimate at all readily changes of external temperature. The viscera give no signs of organic affection in the beginning of the disease. The urine is usually increased in quantity; lowered in specific gravity; and contains no albumin, sugar, or casts. The uterine functions go on as in health. As the affection advances various indications of damage to viscera are declared, and the urine is generally albuminous in the last stage. Then also, together with all the indications of great general debility, the mind often becomes unhinged. Lethargic good temper is exchanged for moroseness, fretfulness, irritability; delusions or hallucinations often follow; and there is a speedy lapse into coma. Death comes either by coma, or with the signs of uræmic poisoning, or by inanition.

Prognosis.—The progress of the disease is not readily affected by any remedy. The prognosis is altogether unfavourable; the duration of observed cases has been from six years upwards.

Treatment.—Something may be done by keeping the patient carefully sheltered from the cold; something by tonics; something by good food. Though these will not cure they will at least help the patient to bear her sufferings better. Of late the writer has found in two cases benefit from the use of vapour baths. In three others under the prolonged use of jaborandi the signs of myxœdema have almost disappeared. Ten to sixty minims of the fluid extract may be given four times daily. Nitro-glycerine has benefited one case. Dr. Andrew Clark regards the disease as fairly curable by careful diet, iron, arsenic, baths, and assiduous frictions.[1] William M. Ord.

# N

**NÆVUS.** *See* Tumours.

**NAILS, Diseases of.**—Synon.: Fr. *Maladies des Ongles*; Ger. *Krankheiten der Nägel.*

Onychopathic or ungual affections admit of a division into—(A.) Diseases of the *nail proper*; and (B.) Diseases of the *soft parts in immediate relation* with the nail.

Under the former head may be considered alterations of colour, texture, figure, and development; and under the latter, affections of the walls of the nails and inflammation.

Ætiology.—The nails, in consequence of their position, are more than usually liable to injury from undue pressure, from blows, and from foreign bodies forced beneath them, such as splinters of wood, pins, and nails. The great vascularity and sensitiveness of the tip of the fingers and toes, and the close adhesion of the bed of the nail to the deeper structures, are at the same time predisposing causes, and causes of greater intensity of result. Syphilis, struma, eczema, psoriasis, and gout are also causes of onychia and paronychia.

**A. Diseases of the Nail Proper.**—1. *Colour.* In colour, the nails, which are naturally clear and translucent, may be brownish or greyish, and dirty in appearance; or they may be opaque in round and circumscribed white spots, or in patches of greater extent. The small, white opaque spots are termed *flores unguium* or *mendacia*, but when of greater extent and producing a more general whiteness, *selene unguium.* The transparency of the nails admits of stains in the derma being visible through them, and these are not to be confounded with discolouration of the nail itself. Stains of this kind result from the development of psoriasis or of syphilis beneath the nail, as also the diffusion of pus and blood, the latter constituting *ecchymoma unguium.*

[1] Since the above was written, many cases of this disease have been described by observers in England and France, but the condition appears to be rare in Germany. These additions to our knowledge make it evident that more men are affected than the earlier observations indicated. Several cases of a typical kind in which males were the subjects have been fully described; and Dr. Andrew Clark has stated that in his experience males have been the more frequent sufferers, namely, in about the proportion of seven to three females. Recent observations again bring out more strongly the fact that the central organs of the nervous system are affected, in many cases to a large extent, by the destructive increase of the connective tissue element. Marked bulbar paralysis has been observed in two cases. Dr. Mahomed has argued strongly in favour of the identity of myxœdema with Bright's disease.

2. *Texture.*—In texture the nail-substance may be hard or soft, thick or thin, brittle or flexible, uneven and rough, or fibrous. *Thick* nail may be the simple consequence of more active production of nail-substance, and in this respect may be contrasted with the thin nail; or it may result from interference of growth in length, which enforces the apposition of lamina after lamina to its under surface, until a thick horizontal mass is formed, or, if it be lifted from its bed, those elongated, horny, and twisted cylinders which resemble horns rather than nails. A third kind of thickening of the nail results from the formation in excessive quantity of a coarse, lamellated cell-substance on the bed of the nail, which lifts the horny plate into an oblique and almost perpendicular position, and gives it the appearance of a claw. This state of the nail is termed *gryphosis* or *onychogryphosis*, and is often the first stage of the horn-like nail.

*Hardness* of texture of the nail may retain its quality of toughness, but is more frequently associated with brittleness to a greater or less extent. In the latter state there may be several longitudinal cracks or fissures in the nail, sinking as deeply as the vascular corium, and the longitudinal fragments may themselves be transversely fissured and broken.

*Softness* of the nail is accompanied with flexibility; and the degree of the latter quality will be governed by the degree of density of the horny plate. In some instances the covering of the matrix and bed of the nail more nearly resembles epidermis than horn, and may be taken to represent an absence of the nail, or *alopecia ungualis*. Usually smooth and polished on its surface, the nail may be *rough*, sometimes apparently fibrous, sometimes crossed by shallow grooves or deep fissures, and sometimes fretted or eroded as if it were worm-eaten. These various appearances have suggested the terms *fissura* and *tinea unguium*, as likewise, *scabrities*, *defœdatio*, and *degeneratio*.

3. *Growth.*—The condition of the nails has relation to the state of the system generally, as it is well known that they undergo an impairment of growth during illnesses which affect the nutritive function of the organism. In the case of the nail this is exhibited by a deficient formation of horny matter, which results in the production of a groove across the nail; and it has been shown by Dr. Wilks and Dr. Beau, that if the rate of growth of the nails be ascertained, the period and duration of the illness may be determined by the position and breadth of the groove.

4. *Figure.*—Aberrations of figure of the nails are exemplified in the broad, thin, curved nail which is met with on the club-shaped fingers of struma, and which has received the name of *unguis aduncus*; in the longitudinally contracted and prominent nail termed keel-shaped, *arctura unguis* or *gryphosis*; and in the depressed, or dish-shaped nail, which looks as if it were tied down in the centre and forced upwards at the circumference.

5. *Development.* — Errors of development of the nail, giving rise to supernumerary nails, are almost entirely restricted to the bifid or double nail, which is associated with a broadening and tendency to bifurcation of the last phalanx.

6. *Parasitic Affections.* *See* TINEA.

B. **Disorders of the Connected Soft Parts.**—Disorders of the soft parts connected with the nail, assume the forms of errors of growth, and inflammation.

1. *Errors of Growth.*—The epidermis which borders the posterior wall of the nail, and is normally adherent to its surface, is apt to be drawn forward with the growth of the nail, and become stretched over its surface as a thin film, which has been likened to a wing, and has received the name of *pterygium unguis*. At other times this border of cuticle splits up into narrow shreds, some of which separate from the nail and curve backwards. In their abnormal position they are liable to become torn; and when the tear, as is usually the case, extends to the corium, there is bleeding and pain, and sometimes inflammation. This is the affection which is known by the term *agnail*, derived from the ancient Saxon word, *ange*, signifying 'angry.'

2. *Onychia.*—Inflammation of the end of the finger, involving the soft parts surrounding and beneath the nail, is termed *onychia*; but when the inflammation is limited to one or other of the walls of the nails, the case is one of *paronychia*.

Onychia presents the ordinary characters of inflammation, modified by extent and degree; by the anatomical construction of the part; and especially by the constitution of the patient. Hence we distinguish a *common*, a *strumous*, and a *syphilitic* onychia; the first probably issuing in suppuration with loss of the nail, the second in prolonged ulceration with fungous vegetation, and the third in deep ulceration. Common onychia is intensely painful, and more rapid in its course than the specific kinds. Sometimes the inflammation is so severe as to destroy the vitality of the bone. The strumous and syphilitic forms of onychia are sometimes associated with much swelling and congestion of the finger-end; and have probably been described as *onychia maligna*.

3. *Paronychia.*—Paronychia, or inflammation of the walls of the nails, sometimes presents itself in an acute form, as in the painful abscess termed *panaris* or whitlow; sometimes as a chronic inflammation of one of the lateral walls of the nail due to pressure against the border of the nail, termed *ingrowing nail*; and sometimes as a chronic thickening of the posterior wall, which, becoming everted and prominent, is termed *ficus ungualis*.

TREATMENT.—A prophylactic of the slighter forms of disorder of the nails, is the bestowal of some care and attention on their culture, to prevent them from growing too long; to prevent the epidermis growing forward on the back of the nail; and at the same time to avoid the loosening of this fold and pressing it back too forcibly.

Onychia and paronychia must be managed according to the general principles of treatment of inflammation. If the cause be obvious, such as the presence of a foreign body or an ingrowing nail, these irritants must be removed. In acute idiopathic onychia, position, pressure, and cold applications are appropriate to its primary stage; and water-dressing or poultice if the pain should be severe. Where the issue is by abscess,

as in whitlow, the first appearance of the pale disk which represents pus should be looked for, and a puncture made to give it exit; whilst chronic inflammation and ulceration are to be treated with stimulant applications, the former with linimentum iodi, the latter with the compound tincture of benzoin and unguentum resinæ; possibly with lunar caustic.

Where an ingrowing nail keeps up a paronychial inflammation, the body of the nail should be thinned by scraping to diminish the force of pressure; and by a little manœuvring, a director may be introduced, beneath the border of the nail, and the edge cut away with a pair of scissors. A minute compress of cotton-wool should then be passed beneath the adjoining part of the nail, so as to direct the ingrowing point upwards and outwards. As a last resource, avulsion or some other surgical procedure may be found necessary.

Its appropriate treatment is removal of the diseased nail, and dressing with powdered nitrate of lead or a lotion of liquor arsenicalis.

Syphilitic, strumous, eczematous, leprous, and gouty onychia and paronychia, besides the ordinary treatment applicable to inflammation in general, will call for specific constitutional and local treatment, for example, iodide of potassium and blackwash for syphilis; cod-liver oil, iron tonics, and nitrate of silver for struma; arsenic for eczema and psoriasis; and colchicum, *inter alia*, for gout. Erasmus Wilson.

**NAPLES, in South Italy.**—Changeable climate. Mean temperature, winter, 48° Fahr. Cold winds in spring. *See* Climate, Treatment of Disease by.

**NARCOSIS** } (ναρκόω, I become torpid).
**NARCOTISM** }
A condition of profound insensibility, due to the introduction of certain poisons, or excessive doses of certain drugs, into the system, such as opium or alcohol; or to the retention there of certain excretory elements as in uræmia. *See* Consciousness, Disorders of; and Narcotics.

**NARCOTICS** (ναρκόω, I become torpid).—Synon.: Fr. *Narcotiques*; Ger. *Narcotische Mittel*.—Definition.—Remedies which promote or artificially imitate the natural physiological processes of sleep; but which in large quantity produce complete insensibility.

Enumeration.—A convenient division of narcotics, in the limited sense of hypnotics, may be made into (1) *indirect* narcotics, which include many soothing and hygienic conditions, Anodynes, Conium, &c.; and (2), *direct* narcotics, of which Opium, Chloral-hydrate, Croton-chloral, Bromide of Potassium, Hyoscyamus, Stramonium, Belladonna, Hop, Indian hemp, Alcohol, Digitalis, and the Anæsthetic vapours are in most general use.

Action.—The *indirect* class of narcotics have no primary influence over the cerebral circulation, but act either by supplying warmth, quiet, and other tranquillising elements, or by removing some disturbing cause which renders sleep impossible. We know how powerfully sleep is under the influence of habit and regularity; how an excess of heat or cold, an inconveniently placed pillow, or a penetrating beam of morning light may often produce more or less restlessness; and the insomnia of feebleness or exhaustion may readily yield to a little nourishment, or to a well-timed dose of alcohol. Rain, again, is in some individuals responsible for many a wakeful hour; and the evacuation of deep-seated pus, the extraction of an aching tooth, or a dose of quinine may sometimes prove as effectual an anodyne as the subcutaneous injection of morphia, or a moderate dose of opium, which stands as the type of this therapeutical group.

Conium may prove narcotic, by stilling the disorderly movements of chorea or of acute mania.

*Direct* narcotics, on the other hand, either produce some specific effect upon the cerebral grey matter, or have a very decided action on the blood-supply of the brain, and by constricting its vessels, produce that degree of anæmia which more or less suspends its functions, and causes sleep. In larger doses, however, an opposite effect results, and we then see the cerebral congestion, the livid face, and the gradually deepening coma, which too surely indicate the fatal termination of opium-poisoning.

Uses.—Enough has been already said regarding the general principles on which we employ indirect narcotics; and the tact and ingenuity of the physician will often be severely taxed to discover the precise cause on which the want of sleep depends. When remedies, however, of the more domestic class have been exhausted, we must have recourse to drugs, and a brief *résumé* may now be given of the advantages and disadvantages of those remedial agents whose soporific qualities have been firmly established by experiment and experience.

Opium and morphia naturally stand first, and still hold their place as our most potent and reliable narcotics, all the more valuable because, almost alone in their class, they are also endowed with powerful anodyne action, in virtue of which they may relieve pain without causing sleep. Valuable as it is in all forms of insomnia, opium is especially indicated in typhus fever and other acute disorders, when delirium and prolonged wakefulness seem to endanger life. The principal drawback to opium is the digestive disturbance following its use, and the fact that as toleration is very rapidly established, gradually increasing doses are needed to check the counteracting influence of habit.

Chloral is less to be recommended in acute diseases, on account of its tendency to cause cardiac failure, but it is of essential service in simple insomnia, in chronic affections where the prolonged use of narcotics is required, and in delirium tremens. In prescribing it we must not forget its weakening action on the heart, and on the respiratory centre, or the petechial and other skin-eruptions which have been described as following its use.

Bromide of potassium is peculiarly well fitted to soothe the brain when rendered irritable by over-work, but we must remember that it is very uncertain as a narcotic, and is apt to produce an eruption, and an uncomfortable degree of muscular weakness. *See* Bromism.

Digitalis is of use when flaccid vessels permit a free flow of blood to the brain, thus effectually

preventing sleep when the patient occupies the recumbent posture, the tonic influence of the drug bracing up the arterial tissues, and enabling a due amount of cerebral anæmia to be obtained.

The other narcotics may be tried when the more potent remedies of the class fail or lose their power; and under certain circumstances a combination may succeed better than simplicity. Thus chloral and bromide of potassium are more valuable in acute mania when given together than alone; and opium and tartar-emetic are well known to form one of our most effectual means of dealing with some of those very intractable forms of sleeplessness which occur in the course of typhus. ROBERT FARQUHARSON.

**NATAL, in South Africa.**—Warm, but healthy climate, with hot, wet summers, and dry, clear winters. High winds from S.E. and N.W. Soil, sandstone and granite. *See* CLIMATE, Treatment of Disease by.

**NAUHEIM, in Germany.**—Gaseous thermal salt waters. *See* MINERAL WATERS.

**NAUSEA** (*ναῦς*, a ship, in relation to sea-sickness).—A feeling of sickness or inclination to vomit, generally accompanied by a sense of disgust or loathing, and sometimes by a feeling of great depression. *See* SEA-SICKNESS; and VOMITING.

**NAUSEANTS** (*ναῦς*, a ship).—DEFINITION. Agents which produce the condition of nausea.

ENUMERATION.—The principal nauseants are Warm water, Tartar-emetic, Ipecacuanha, Tobacco, Squill, and Apomorphia.

ACTION.—These substances produce irritation of the stomach, loss of appetite, general malaise, enfeebled circulation, muscular weakness, and frequently also salivation and sweating.

USES.—Nauseants have been employed to diminish appetite, in the hope of causing absorption of fatty accumulations, or of pathological deposits. They are also used in producing relaxation of involuntary muscular fibre, and thus accelerating the passage of calculi through the bile-duct or the ureters. They were formerly used to produce relaxation of voluntary muscles, in order to facilitate the reduction of dislocations, or to subdue the paroxysms of delirium or mania. For such purposes, however, they are now replaced by anæsthetics or other sedative measures. They are still used to excite sweating. *See* DIAPHORETICS; and EMETICS.

T. LAUDER BRUNTON.

**NEAR-SIGHTEDNESS.** *See* MYOPIA; and VISION, Disorders of.

**NECRO-BIOSIS** (*νεκρός*, a dead body, and *βίος*, life).—Molecular death of a tissue without loss of continuity, especially seen in the various forms of atrophy and degeneration. *See* ATROPHY; and DEGENERATION.

**NECROPSY** (*νεκρός*, a dead body; and *σκοπέω*, I inspect).—SYNON.: Fr. *Nécropsie*; Ger. *Leichenschau.*

DEFINITION.—The inspection of the body after death.

METHOD.—After making a complete external inspection of the body, and noticing the general appearance, *rigor mortis*, change of colour, whether partial or general, œdema, marks of injury, and other points, a *post-mortem* examination should begin with the head, or, if the spinal cord is to be examined, with the spine.

*Head.*—To open the head, make an incision down to the bone, across the vertex from the base of one mastoid process to the other, and reflect the scalp backwards and forwards; then divide the bone all round with the saw, beginning in front a little above the level of the superciliary ridge. The posterior half of this section should make an angle with the anterior half by being brought over the occipital bone, a little behind the apex of the lambdoidal suture. By this means the skull-cap will, when replaced, rest firmly in its position without slipping back and so causing disfigurement of the forehead. In cases of fracture of the skull the section should be completed with the saw, care being taken not to wound the dura mater. Under other circumstances the inner table may be conveniently divided with a chisel and mallet. The skull-cap must now be forcibly dragged off; if very adherent to the dura mater, a long flexible spatula may be introduced between them, and separation effected.

In young subjects, before the sutures and fontanelles are united, it is better to remove the dura mater and skull-cap together, by dividing the former with blunt-pointed scissors in a line with the section through the bone, and then cutting through the falx at its anterior and posterior attachments.

The longitudinal sinus may now be opened and examined. The dura mater should next be divided on each side with blunt-pointed scissors, or on the level of the section through the bone, and the two lateral flaps turned up; the falx should next be divided near its anterior attachment, and the whole membrane drawn backwards off the hemispheres. The brain must now be removed; a long narrow scalpel being used to cut through the nerves and vessels, whilst the tentorium is most safely divided with blunt-pointed scissors. The spinal cord should be cut as low as possible. Any fluid present at the base of the skull should be drawn off with a syringe and measured.

*Brain.*—After examining the pia mater, it should be entirely stripped off, and the surface of the brain examined. It should then be placed on its base, and, if very soft, supported by a towel wrapped round it. A horizontal incision should then be carried through each cerebral hemisphere, on a level with the upper surface of the corpus callosum, from within outwards, not quite reaching the surface, so as to leave the hemispheres still attached to the rest of the brain. These should be turned back, and numerous vertical incisions made in the upturned surface. Each lateral ventricle should then be opened by a vertical incision through its roof, and any fluid contents withdrawn by a syringe. The fornix should now be divided in front, and with the septum and corpus callosum turned backwards. The velum interpositum and choroid plexus being reflected in a similar manner,

numerous longitudinal incisions should then be made in the corpora striata and thalami optici, and in the corpora quadrigemina. An incision should now be made through the superior vermiform process of the cerebellum, so as to lay open the fourth ventricle. The cerebellum may be examined by making parallel incisions on each side through its lobes, not quite detaching the sections. The brain may now be folded together again, and the under surface turned up and examined. Incisions should be made into the under surface of the cerebral lobes, and into the crura and pons; and the medulla divided transversely at different levels. Softened portions should be tested with a stream of water; and parts reserved for microscopical examination at once placed in a hardening solution, such as chromic acid 1 per cent.

A method of examining the cerebrum preferable to the above, when it is desired to determine accurately the exact seat of lesions, is the one recommended by Dr. Pitres.

The cerebral hemispheres having been separated and stripped of their pia mater, are divided into three portions by two transverse vertical incisions, the first passing about two inches in front of the fissure of Rolando, the second a little less than half an inch in front of the internal perpendicular fissure, the occipito-parietal fissure of Huxley, which divides the parietal from the occipital lobe of the cerebrum. The cerebrum will thus be divided into three portions, an anterior or prefrontal, a middle or fronto-parietal, and a posterior or occipital. The first and last portions correspond to the non-excitable parts of the cerebrum, lesions of which do not cause either motor or sensory disturbances. The middle region, on the contrary, comprises the corpus striatum and optic thalamus, and the cortical motor zone.

This central portion may be best examined by making four vertical sections by incisions parallel to the fissure of Rolando. The first, or pediculo-frontal section is made by an incision about three-quarters of an inch in front of the fissure of Rolando, dividing the second and third frontal convolutions close to their insertion into the ascending frontal convolution. This section will especially comprise the third frontal convolution. On its surface are seen sections of the three frontal convolutions, the anterior extremity of the island of Reil, the posterior extremity of the orbitar convolutions, the caudate and lenticular nuclei of the corpus striatum separated by the internal capsule.

The second, or frontal section, is made by an incision at the level of the ascending frontal convolution. Its surface displays a section of the ascending frontal convolution in all its extent, the convolutions of the sphenoidal lobe, the island of Reil, the external capsule and the claustrum, the caudate nucleus, the lenticular nucleus at its thickest part, and the optic thalamus.

The third, or parietal section, is made by an incision carried through the ascending parietal convolution. It much resembles the former, but the lenticular nucleus and the claustrum are divided where they are smaller.

The fourth, or pediculo-parietal section, is made by an incision about an inch behind the fissure of Rolando at the level of the foot of the parietal lobules, and passes through the posterior extremity of the optic thalamus. The lenticular ganglion is no longer visible; the corona radiata is divided in the region where lesions produce hemianæsthesia.

By means of these sections the exact relations of lesions of the cerebrum can be made out with much greater accuracy than by the ordinary methods of examination.

*Base of Skull, Orbit, and Internal Ear.*—The base of the skull and its sinuses may now be examined. In cases of fracture, the dura mater should be carefully stripped off, so as to expose the surface of the bone. The contents of the orbit may be examined by removing its roof. The tympanum can be opened by cutting through with a chisel the plate of bone forming its roof. This is situated on the anterior surface of the petrous bone, just in front of the eminence of the superior semicircular canal. To examine the internal ear the petrous bone must be removed. This is best done by two converging incisions made with a saw, and then separating its apex from the sphenoid and occipital bones with the chisel.

*Spinal Cord.*—To examine the spinal cord the body must be turned on its face, with the head hanging over the table, and a block placed under the chest. An incision must be made over the vertebral spines from the top of the sacrum to the occiput, and the vertebral arches laid bare. These are best divided with the rachitome, a double semi-circular saw, in the absence of which a short common saw may be used, or a chisel and mallet. The cord should be removed in its tube of dura mater, the latter being held by the forceps, and care taken not to bend the cord abruptly. The dura mater should then be slit open with blunt-pointed scissors along its anterior and posterior surfaces, and the cord examined, with as little handling as possible, by means of transverse sections made with a sharp scalpel. For microscopical examination the cord may be placed in spirit for about twenty-four hours; and then, after removal of its membranes, cut into lengths, and transferred to a one per cent. solution of chromic acid.

A method of opening the spinal canal from the front, preferable in many respects to the above, is practised at Vienna and many places on the Continent. The instruments used are a strong knife-shaped chisel, with a cutting beak, and a mallet. After the removal of the thoracic and abdominal viscera, the beak of the chisel is introduced into the lowest intervertebral foramen, and, by successive blows of the mallet, the pedicles of the vertebræ are cut through on each side and the canal exposed by removing the bodies. In this way great disfigurement of the body and soiling of the table and linen are avoided, and the spinal ganglia are more easily examined.

*Thorax and Abdomen.*—The thorax and abdomen should now be examined. It is better to lay the abdominal cavity fully open before removing the sternum. In cutting through the first rib, and disarticulating the clavicle, care should be taken not to wound the innominate vein.

By using cutting pliers, which should be directed so as to cut obliquely through the rib into the articulation, all danger is avoided.

If much ascites is present, the belly should be tapped before laying open the peritoneal cavity. So, if either pleura be full of fluid, which will be shown by its pouring out when the cartilages of the ribs are cut through, sufficient should be drawn off with a syringe to prevent any overflow when the sternum is removed.

The lungs should now be drawn out of the chest, adhesions separated, and their posterior surfaces examined. The contents of the mediastinum should next be inspected, and the pericardium opened. If the case be one of thoracic aneurism, mediastinal tumour, or malformation of the heart or great vessels, the heart and lungs should be removed together. Otherwise, the heart may be first removed and examined.

*Heart.*—The auricles should be laid freely open with a pair of scissors, by an incision joining the mouths of the great veins and carried to the extremity of the auricular appendage. The competency of the valves may then be tested. All clots must first be removed, the heart held in an upright position, and water poured into the aorta and pulmonary artery successively, the semilunar valves being held back with the handle of a scalpel to allow the ventricle to become filled; on looking into the auricles the competency of the auriculo-ventricular valves may be estimated. To test the semilunar valves an opening must be made into each ventricle; the pulmonary artery and aorta cut sufficiently short to enable the valves to be clearly seen; and then water poured into these two vessels successively, and the valves looked at from above. The right ventricle may now be opened. The left forefinger should be introduced through the pulmonary artery, and the anterior wall of the ventricle divided with blunt-pointed scissors into the artery, the point of the scissors being guided by the left forefinger to the junction of the valves. The pulmonary artery and aorta should then be separated as much as possible, and the left ventricle opened in a similar manner along its anterior wall, the left forefinger as before guiding the scissors to the point of junction of the semilunar valves. The incision must be carried close to the ventricular septum, and the septum between the aorta and pulmonary artery, but without cutting the latter. The most accurate way of measuring the capacity of the orifices is to pass through them graduated balls fixed on rods, in default of which the fingers may be used.

*Lungs.*—To remove the lungs, the trachea must be cut across at the root of the neck, and well drawn forwards by inserting the middle finger into the lower end, and the other fingers on each side behind the bifurcation, care being taken not to cut the œsophagus.

*Larynx and Pharynx.*—To remove the larynx and pharynx, the incision in the neck must be carried up to the chin; the floor of the mouth opened from below; the left forefinger introduced, and used to depress the tongue; a long narrow scalpel introduced above the finger, and carried along each side of the ramus of the jaw; the tongue then drawn down under the chin; and the soft palate and pharynx divided transversely. The pharynx and larynx should then be opened along their posterior walls.

*Intestines.*—In examining the abdomen it is most convenient to begin with the intestines. The large intestines should be divided between two ligatures below the sigmoid flexure, and drawn out, cutting the mesentery close to the bowel. This process should be continued till the duodenum is reached, when it may be again tied and cut. The intestine should be opened along the line of attachment of the mesentery.

*Spleen.*—The spleen may next be examined. It should be drawn forwards out of the abdomen, and the gastro-splenic omentum cut through.

*Stomach.*—The stomach should next be removed. A double ligature should be placed round the duodenum about two inches below the pylorus, and another one round the lower end of the œsophagus, and these tubes cut through, so as to remove the stomach without the escape of its contents. If required for chemical analysis, the contents should be emptied into a glass vessel, by removing the œsophageal ligature.

The usual practice is to lay open the stomach along its lesser curvature, from the œsophagus to the duodenum; but in many cases it is better to carry the incision along the greater curvature, for, as ulcers and cancers are more frequently situated near the lesser curvature, this incision is more likely to avoid cutting through them.

Unless required for chemical analysis, the mucous membrane may be washed by a gentle stream of water and then examined.

*Pancreas.*—After the removal of the stomach the pancreas may be conveniently examined. Before separating it from the duodenum the condition of its duct should be ascertained.

*Liver.*—In all cases of jaundice the liver and duodenum should be removed together, so as to obtain the bile-duct intact. In removing the liver care should be taken not to injure the right suprarenal capsule, which is in close contact and often adherent. In testing the perviousness of the bile-ducts it is better not to squeeze the gall-bladder, as this will often overcome an obstruction, but to open the duct with scissors, and observe the colour of the lining membrane below an obstruction. This will be found unstained by bile.

*Supra-renal Capsules.*—In cases of Addison's disease the supra-renal capsules should be removed, united with the semilunar ganglia and solar plexus.

*Genito-urinary Organs.*—In all cases of urinary obstruction the kidney, ureters, and bladder should be removed in connexion. The pelvic organs may be removed *en masse* by carrying a large knife all round the pelvic walls, and drawing the viscera upwards and backwards. As much of the urethra as may be required can be pulled back under the pubic arch. The urethra and bladder should be opened with scissors along their upper wall.

The uterus may be examined by introducing one blade of a pair of probe-pointed scissors through the os; making an incision through the anterior or posterior wall to the fundus; and carrying this on each side to the entrance of the Fallopian tubes.

The kidney may be bisected by an incision through it from the convex border to the hilus; the capsules should then be stripped off, their thickness and degree of adhesion being noticed, and the state of the surface of the kidney, both external and on section, carefully observed.

W. Cayley.

**NECROSIS** (*νεκρὸς*, a dead body).—The absolute death of a circumscribed portion of any tissue, but the phrase is usually associated with death of bone. *See* Bone, Diseases of.

**NEOPLASMS** (*νέος*, new, and *πλάσσω*, I mould).—A term for new growths. *See* Tumours.

**NEPHRALGIA** (*νεφρὸς*, the kidney, and *ἄλγος*, pain).—Definition.—An affection of the nerves of the kidney, unattended by any evident anatomical lesion; characterised by the occurrence of pain in the region of the kidney, sometimes periodic, often accompanying exhaustion, but without any morbid changes in the urine.

Ætiology.—Exhaustion, exposure to cold, malarious poison, and the nervous, rheumatic, or gouty constitutions, are to be ranked amongst the chief causes of nephralgia. It is probable that the pains in the kidney, due to the presence of calculi in its pelvis, are at times of a purely neuralgic character.

Symptoms.—Neuralgic pain in the region of the kidney is sometimes paroxysmal and very intense, at other times more continued and less severe. It is frequently periodic, and is apt to occur when the patient is exhausted, or in a state of nervous depression. It is unattended by any change in the quantity or appearance of the urine, and the pain does not tend to dart down in the direction of the ureter, while tender spots may generally be discovered in the neighbourhood of the spinal column.

Diagnosis.—The disease with which nephralgia is most apt to be confounded is renal calculus. The points upon which reliance is to be placed in making the diagnosis are the exact seat of the pain, and the direction in which it spreads; the presence or absence of tender spots in the lumbar region; and the condition of the urine. In renal calculus the urine is commonly bloody, and contains crystals or groups of crystals, or minute calculi, while in nephralgia it is natural.

Prognosis.—The prognosis of nephralgia is favourable.

Treatment.—The severity of the pain may be such as to demand subcutaneous injection of morphia. The most valuable remedy for cure is quinine, which may be given in doses of five, ten, or even twenty grains two or three times in the course of the day. Iron, arsenic, chloride of ammonium, acupuncture, or Corrigan's cautery may be employed in suitable cases, if the quinine fail.

T. Grainger Stewart.

**NEPHRITIC COLIC** (*νεφρὸς*, the kidney). A synonym for renal colic, an affection which is usually due to the presence or passage of a renal calculus. *See* Renal Calculus.

**NEPHRITIS** (*νεφρὸς*, the kidney). — A general term for inflammation of the kidney. *See* Bright's Disease; and Kidney, Diseases of.

**NERVES, Diseases of.** — Synon.: Fr. *Maladies des Nerfs*; Ger. *Nervenkrankheiten*.—Nerves, in their origin, course, and distribution, are connected with the several organs and tissues of the body, and are consequently affected in various ways when such parts are disordered or diseased. But, besides such *secondary* derangements, nerves are subject to many morbid conditions which affect them *primarily*. In the case of certain classes of nerves, connected with special functions, the effects produced by disease are at once so distinct and so important, that they require separate consideration. Such, for example, are the glosso-pharyngeal, hypoglossal, olfactory, optic, phrenic, pneumogastric, spinal accessory, sixth and third cranial nerves, the morbid conditions of which will be found fully discussed under their respective headings. Again, certain forms of congestion or inflammation (whether occurring in the subjects of gout, rheumatism, malaria, plumbism, syphilis, or in other states), when they affect important nerves, cause symptoms of a character so marked, either in their progress or distribution or by their severity, as to deserve a special designation, and to demand separate description (*see* Intercostal Neuralgia; Neuritis; Sciatica; and Tic-Douloureux). In these and in other allied instances the prominent symptoms are referable to functional disturbances of the nerves. In another class of cases similar phenomena originate in interference with the general nutrition, in disease of the nervous centres, or by reflex action; and these phenomena will be found discussed in the articles upon Convulsions, Neuralgia, &c.

In this place there remain for special consideration the following subjects:—(1) the effects of *injuries* of nerves; (2) the most common morbid growths involving nerves, which are generally known as *neuromata*; and (3) the effect of cutting or stretching nerves regarded as a means of *treatment*.

1. **Nerves, Injuries of.**—Nerves may be divided accidentally either by tearing or cutting, or surgically during an operation, or for the relief of pain or resection of tumours. The nerves most frequently divided accidentally are those of the upper extremity, especially the ulnar as it passes behind the inner humeral condyle, or as it lies upon the anterior annular ligament. The median and musculo-spiral nerves are also not unfrequently divided by deep cuts, on the fleshy front of the upper fore-arm or wrist.

Sometimes, besides being wholly or partially divided, nerves may be bruised, or have imbedded in their substance particles of friable foreign bodies, such as glass or slate. Fractures of the humerus at the upper or lower third, are not uncommonly complicated by laceration of the musculo-spiral nerve, by the sharp edge of one of the fragments; for the nerve passes spirally round and in close contact with the bone, first on the inner, then on the hinder, and near the elbow at the outer aspect of the bone.

Symptoms.—The symptoms of the division of a nerve are loss of power in the muscles, and of sensation in the skin supplied by the offsets of the injured nerve, as, for example, the radial and

posterior inter-osseous branches of the musculo-spiral. The complete or the partial division may be diagnosed by the more or less complete interruption of their functions.

Nerves unite, if the cut ends are placed in apposition, as readily as other structures; but it is usually some time before the sensory or motor functions are restored, and then only by slow degrees, the former usually taking place sooner. The recovery is sometimes delayed by displacement or error in the co-aptation of the cut fibrils, and then the brain seems to require some education and training to correct misplaced impressions, which, however, is in most cases accomplished ultimately more or less perfectly. When an important nerve, such as the great sciatic, is divided, the part of the limb supplied by it suffers in its nutrition, and is apt to become wasted, and if the patient be growing, to lag behind its fellow in development. Sometimes the muscles may become atrophied; and if the division is not united in due time, the fibres become subject to fatty degeneration, and may not afterwards regain their power. Other tissues besides the muscles may likewise become atrophied. Thus wasting or atrophy of the fingers may result from injury of the ulnar or median nerve. This has been thought to be in some degree due to the interruption of innervation in certain fibres, which are bound up in the spinal as well as in the sympathetic nervous systems, and which preside over and control the nutrition of the tissues, the so-called *trophic* nerves. The parts supplied by them seem to be more liable to the formation of sloughing sores, as is illustrated by the bed-sores which are apt to follow division of or pressure upon the spinal cord, or *cauda equina* in fractures of the spine. Severe contusions of nerves will sometimes so interrupt their functional power as to produce the results of complete division.

Treatment.—In the treatment of nerves accidentally divided all foreign bodies are, in the first place, to be carefully removed by sponge or forceps, with as little further injury to the nerve-tissue as possible; and the wound, if practicable, is to be treated antiseptically. Then the limb should be fixed upon splints in a position which will bring most easily and closely the cut ends of the divided nerve into apposition. Carbolised catgut ligature may be applied upon the nerve-sheath or closely adjacent textures, so as to hold the cut ends evenly together; or a thin wire may be applied to the neighbouring tissues, brought out at the surface, and secured over shot or buttons, and the wound treated in the ordinary way. If possible, none of the nerve-fibres should be cut away, although a slight trimming off of jagged ends may be advisable. Passive motion of the paralysed muscles should be employed, as soon as the wound is united; and afterwards weak faradization should be applied to the limb, to promote nutrition and stimulate nerve-currents.

2. **Nerves, Tumours of.**—Synon.: *Neuromata.*

The tumours which affect nerve-structure, although no doubt varying in essential character, as they do in other parts of the body, have usually been grouped indiscriminately under this head. Surgically they may be classed thus:—(*a*) *constitutional*, which affect the whole of a particular group or groups of nerves, and are clearly constitutional in their origin; and (*b*) *traumatic*, such as form on the cut ends of nerves after amputation, or result from local injury of some kind.

(*a*) *Constitutional.*—Numerous cases of multiple neuromata are on record. In one case, recorded by R. W. Smith, upwards of 2,000 tumours were found. In most instances they are confined to one particular set of nerves and their branches. For instance, they have been found in the posterior tibial and plantar nerves, as in a case recorded by Van der Byl (*Pathological Society's Transactions*, vol. vi.), where the growth may have been round-celled sarcoma or cancer. In another remarkable case of multiple neuromata, recorded by Dr. Wilks (*op. cit.*, vol. x.), perhaps of syphilitic origin, a simple fibroid deposit was found within the neurilemma, causing in some places hardening and contraction, and in others neuromatous tumours. One of these had formed in the substance of the pneumogastric nerve, and was thought by Dr. Wilks to have caused the disease of the lung which proved fatal. In another case, recorded by Mr. F. Smith, multiple tumours affected the internal cutaneous and interosseous nerves of the arm, and the larger tumours were found to have undergone calcareous degeneration (*op. cit.* vol. xii.).

A single neuromatous tumour has been found on the auditory nerve, causing deafness (Toynbee, *op. cit.* vol. iv.), and on the musculo-spiral nerve in several recorded cases (*op. cit.* vol. viii.), by Nunn and Barber. In one of these cases acute sensibility and intense pain in the course of the distribution of the nerve were present. In the other case, no pain was felt unless the tumour was pressed. In a tumour upon the same nerve, recorded by Shillitoe (*op. cit.*, vol. x.), of the size of a billiard ball, a blood-cyst containing clot and serum was found in the interior, surrounded by fibro-cellular structure.

*b. Traumatic.*—Neuromatous tumours which form on the cut ends of nerves after amputation, are rounded or oval masses placed near, but not usually quite at, the extremity of the cut nerve. A small portion of the extreme end frequently forms a sort of tapering tail to the tumour, giving to it a resemblance to a turnip-radish. On section the tumour is found to consist of a fibroid substance, hard, resisting, and firm to the touch, with a somewhat glistening surface. Under the microscope there are seen the same general characters which are found in neuromata, namely, fibroid elongated or spindle cells within and around the neurilemma, pressing upon and displacing the nerve-tubules, which are seen convoluted, distorted, varicose, or lost entirely in the tumour-substance. Some few may be traced through the tumour itself into the tail-like termination, but this latter usually consists of fibrous tissue only. These tumours seem to occur more commonly after amputation of the upper than of the lower extremity. These neuromata are not uncommonly associated with pain, more or less acute at intervals. They may last a long time—in some cases during the whole of the life of the individual. Sometimes neuromata give rise to

acute sensibility or tenderness of the stump, and more rarely to spasmodic twitchings of the muscles or even epileptiform convulsions.

Treatment.—Neuromata on the continuity of a nerve, if painful or situated so as to be easily accessible, and liable to injury, may be dissected out carefully and with antiseptic precautions. Sometimes it will be found that the tumour can be extirpated without taking away the entire section and continuity of the nerve, which when a large one (as for instance the great sciatic) it is important to preserve. In case this cannot be done, the whole section of the nerve-trunk may be taken away, and the smoothly cut ends brought together with fine catgut sutures put through the outer nerve-sheath only, the limb being placed in a position to relax the nerve and lessen tension to the utmost. This proceeding, as before remarked, has been successful in uniting the ends of nerves accidentally cut through.

In cases of neuromata in stumps the same treatment is sometimes available and effective. Opening the cicatrix and dissecting out the tumour or tumours may be all that is required. But in other instances the pain and tenderness are so diffused, and the growths so numerous, that re-amputation a few inches higher up, gives more complete and satisfactory results. Yet in some patients the tendency to the formation of these tumours is so great that they reappear, even after re-amputation, and the prognosis must always be guarded on this point.

3. **Nerves, Surgical Division and Stretching of.**

(*a*) *Nerve-section.* Synon.: Neurotomy.—Surgical division of nerves has been employed for the cure of painful affections such as neuralgia, and for tetanus and other obstinate and sustained spasmodic movements. It has been usually performed subcutaneously, and most frequently in the case of the branches of the tri-facial nerve, at their exit from the bony foramina, such as the supra-orbital, the infra-orbital, and the mental branches. The division should be thoroughly and completely done. It has been found, however, that in a comparatively short space of time, the operation, though perfectly successful in removing the pain and sensation at the peripheral distribution of the nerve, is of no avail. The nerve, after simple subcutaneous division, unites in a few weeks or months; and first sensation and then pain recur in the part. In cases of intracranial disease the operation is of course useless. Efforts have been directed to prevent this union of the cut nerve, by taking away a considerable portion, so as absolutely to prevent contact of the ends; and the operation then must necessarily lose its subcutaneous character. When the nerve, as in those nerves above-named, spreads out to its distribution in all directions, it is difficult to secure this absolute removal, and a good deal of the adjacent soft parts must be excised to insure its being done thoroughly. In a case of obstinate neuralgia of the inferior dental nerve, the late Sir William Fergusson gouged away the outer wall of the mental foramen for the space of an inch, and dissected out the nerve from the canal to the same extent, with the effect of curing the disease.

In some neuralgic cases the cause of the pain lies within the cranium or brain itself, as above mentioned, and is of course not to be reached by surgical operation.

In traumatic tetanus division of the nerve going to the wounded part has been practised by Hilton (*Medical Times and Gazette*, vol. i. 1869), and by Sir Joseph Fayrer (*Rankin's Abstract*, 1863, vol. ii.), as well as by Nelaton and others. The results, however, do not seem to be as favourable as in the more recently introduced treatment of nerve-stretching, whilst the injury inflicted on the structures is certainly greater, and the disabling results are more apt to be permanent.

(*b*) *Nerve-stretching.*—This is one of the modern modes of the treatment of disease, which has so far achieved a certain amount of success. It has been practised in cases in which section of the nerve may be considered justifiable, such as continued and severe pain or spasm, acute or chronic, of the parts supplied by a nerve, which has resisted all milder treatment, and in locomotor ataxy. Cases of traumatic tetanus also claim a trial of this method of cure.

Method.—Nerve-stretching is effected by cutting down upon the nerve-trunk, detaching it from its connections for the space of a few inches, laying hold of it with the fingers, forcibly stretching the whole nerve from its origin to such an extent as to affect powerfully its functions, and then closing up the wound. In some instances a certain amount of loss of sensation or muscular power in parts to which the nerve is distributed is the immediate result, which, however, passes away after a certain interval, and the nerve-function becomes more or less completely restored.

Applications.—A number of cases have been recorded within the last few years, in which nerve-stretching has been employed with considerable success. Thus in a case of spasm affecting the whole of the muscles of the left arm, with considerable anæsthesia, Nussbaum, of Munich, stretched the nerves of the arm in three places—namely, the ulnar nerve at the elbow; the median, musculo-spiral, and ulnar in the axilla; and the primary trunks of the three lower cervical nerves above the clavicle. The patient recovered in eleven weeks, with restoration of the healthy action of the muscles of the limb.

The late Mr. Callender has described the case of a man in whom re-amputation of the stump of the fore-arm for neuralgia had been performed, and which he operated on by stretching the median nerve for three-fourths of an inch. There was no return of the pain, and the nutrition of the stump and arm, which had wasted, was much improved. The writer lately cut down upon and stretched the external popliteal (peroneal) nerve, behind the biceps cruris tendon, in a case of painful spasm of the extensor and peroneal muscles, with a success which was permanent months afterwards. Still more recently Mr. Godlee has treated two cases of facial spasm of many years' standing, by stretching the *portio dura* at its exit from the stylo-mastoid foramen, one with complete success.

In cases of traumatic tetanus, the application

of nerve-stretching seems sufficiently appropriate, and accordingly it has not failed to be tried. A striking case of this description is recorded in the *Centralblatt für Chirurgie*, Oct. 7, 1876, No. 10, by Vogt. In fifteen cases of tetanus collected by Johnstone of Kentucky, seven of which were operated on in late stages of disease, it is stated that there were five cases of recovery from this fatal disease—a much greater proportion than from any other method of treatment. The results in cases of nerve-stretching for traumatic tetanus, practised in London during the last few years, do not add to the favourable impression that the preceding cases were calculated to give as to the efficacy of this operation. It has been tried in various hospitals, lately in King's College Hospital, without success. In one case it seemed rather to hasten the fatal termination. And it can scarcely be said that the infliction of a further injury on the continuity of the nerves of the affected part, with a corresponding impression upon the nerve-centres, is, *à priori*, likely to cure the consequences of a primary injury, which has already so powerfully and fatally influenced the condition of these same nerve-centres.

Still more recently nerve-stretching has been practised upon the nerves of the limb for the relief of the pains of locomotor ataxy. The results, in some instances, appear to have been successful even beyond expectation; for not only have the pains been removed, but the disturbances of co-ordination have also been diminished, though to a limited extent.

PRINCIPLES.—A satisfactory explanation of the *modus operandi* of nerve-stretching is not easily given. Nussbaum suggested that the success may be owing to an alteration in the relations between the nerve-fibres, having the effect of improving their nutrition; whilst Callender attributed it to the consequent numbing of the nerve, that is, the temporary suspension of its functions, by interfering with the transit of painful and abnormal impressions, the nerve-centres having time to resume their normal control. With regard to this explanation it may be pointed out, however, that both motion and sensation are often uninterruptedly retained after the successful stretching of a large nerve.

In certain cases of rheumatic neuralgia it might be conjectured that a degree of contraction may follow a rheumatic or gouty deposit in the nerve-sheath, and thus affect the nerve-current in the central axis of the fibre; and that this may be drawn out, overcome, or broken by the nerve-stretching, the normal function of the nerve-tubule being thus restored temporarily or permanently. Whether a similar explanation will suffice for the recorded cases of cure of tetanus may be more than doubtful, and we must wait for further evidence of fact before we can explain the phenomena with any appearance of probability. Brown-Séquard has recommended exposure of the nerve, and washing it with ether, to effect the same end.

JOHN WOOD.

**NERVI, in the Eastern Italian Riviera,** Warm, moist, winter climate. *See* CLIMATE, Treatment of Disease by.

**NERVOUS.**—A term used variously in reference to persons, to temperaments, or to morbid conditions. A person is said to be nervous, or of a nervous *temperament*, who seems to present a special susceptibility to pain, or who exhibits an undue mobility, as it is termed, of the nervous system—that is to say, when the person starts or shakes on the occasion of abrupt or intense sensorial impressions, or when he exhibits a proneness to convulsions or manifests an exalted emotional susceptibility. An organisation of this kind characterises children rather than adults, and, amongst the latter, females more than males. Nevertheless, in persons of both sexes such a bodily disposition is frequently to be met with, varying not only in degree, but also in kind or type. As one of the most important of these varieties, we must include the as yet very imperfectly understood condition known as hysteria (*see* HYSTERIA). A nervous disposition may be either inherited, or acquired during the life of the individual, and it then ensues as a sequence of some severe illness, of some grave anxiety, or of some physical or moral shock.

In reference to *disease*, the term nervous is used with different significations in different cases. Sometimes it is used in more general terms to signify that the disease is one implicating the nervous system rather than any other part of the body. At other times the use of the term is very variable. Thus, by the term 'nervous aphonia' we imply that the voicelessness is due to some functional nervous inhibition, rather than to any distinct paralytic condition caused by structural disease; whilst, by the term 'nervous deafness,' we should imply that the deafness is due to disease, functional or organic, of the auditory nerve or its centres, rather than to an inflammatory or other affection of the middle ear. H. CHARLTON BASTIAN.

**NERVOUSNESS.**—A term applied to the state of, or to the conditions manifested by, a person coming within the description of 'nervous' as above defined. *See* NERVOUS.

**NERVOUS SYSTEM, Diseases of.**—The complexity of the nervous system, its manifold functions, and its extensive distribution, render its diseases more varied than those of any other system of the body.

From the manner in which the nervous and vascular systems interlock, their diseases or pathological conditions are to some extent inseparably related to one another. The modes of interference with the functions of the vascular system through altered nervous action are comparatively few and simple. The heart may, under the influence of modified nervous stimulation depart from its customary order and rate of contraction, or in extreme cases cease to beat; the smaller arteries over a greater or less extent of the body may diminish in their calibre, or become dilated; but, save for such events as these and their direct consequences, the work of the vascular system is habitually carried on without variations impressed upon it by abnormal states of the nervous system.

On the other hand, the diseases of the nervous system which may be induced by altered quality

of blood, or by alteration of function in the heart or some part of the vascular system, are numerous and varied. The functional activity of the system as a whole may be degraded, owing to the fact of its receiving an inadequate amount of blood from a feeble or slowly acting heart. Or the functions of a part of the system may be interfered with by an undue contraction or dilatation in its small arteries, or by an impediment to the outflow of blood, inducing a mechanical congestion. Again the complete or partial arrest of the blood-flow in the vessels of some important region (owing to thrombosis or embolism therein), or the rupture of one of the branches of such a vessel, with extravasation of blood into the organ,—either of these events may impair or destroy the functions of that particular part, even if it cause no more general disturbance of nerve-function. In short, both local perversions of function and structural changes in the nervous system, are far more frequently initiated by altered quality of blood, or unnatural phenomena in the vessels of the part, than by primary morbid changes in either of the other two components of nerve-tissue, namely, the nerve-elements themselves, or their interstitial connective tissue.

But, as already intimated, the number of different nervous diseases is referable principally to the great complexity of this system. It is now a familiar fact that the same kind of morbid change existing in different parts of the nervous system tends to give rise to wholly dissimilar groups of symptoms. Hence the importance, from a clinical point of view, of studying the varied functions and functional relationships of the several parts of the nervous system.

The most practical and useful classification of the principal component parts of the nervous system is as follows :—

1. The Cerebro-Spinal Division (or *Nervous system of animal life*).
   - *a.* The Encephalon.
   - *b.* The Spinal Cord.
   - *c.* The Encephalic and Spinal Nerves.
2. The Organic Division (or *Nervous system of vegetative life*).
   - *a.* The Pneumogastric or Vagus Nerves.
   - *b.* The Great Sympathetic System (with which is included the 'Vaso-Motor' System of Nerves).

This classification, though in part natural, is also in other respects purely artificial. The cerebro-spinal and the organic nerve-centres are structurally continuous at many points. The vagus nerves, and the vaso-motor system of fibres in part, have an encephalic origin, though the latter are distributed almost throughout with the sympathetic system, of which it is often supposed to constitute the most important part. This sympathetic system is connected at intervals with the whole length of the cerebro-spinal system, from the lumbar enlargement to the base of the brain, chiefly by connecting filaments passing between it and the anterior spinal nerves. Some of these connecting filaments are afferent, others are efferent. The brain again is brought into immediate relation with the sympathetic system through the wide-spread filaments of the pneumogastric nerves, which mingle with almost all the visceral plexuses both of the thorax and of the abdomen. The spinal accessories seem to be the motor nerves through which the more direct impressions brought to the medulla by the pneumogastrics are reflected upon some of the viscera; and, similarly, the tranference of motor-stimuli direct from the spinal cord to the viscera, in response to afferent impressions conveyed to it by certain nerves of the sympathetic system, takes place through motor fibrils in the filaments connecting the anterior spinal nerves with this system. The sympathetic system also possesses its own intrinsic motor fibres and vaso-motor centres. Other intrinsic motor centres probably exist amongst the sympathetic ganglia, which, like those of the heart, may be capable of bringing about muscular contractions in the parts with which they are severally in relation.

The direct consequence of the close relationship between the viscera and the fibres of the pneumogastric and spinal accessory, as well as between the spinal motor nerves, and those emanating from the central connections of the vaso-motor system, is that we find lesions of some portions of the cerebro-spinal system frequently involving altered actions in parts under the immediate influence of the nervous system of organic life—as when diseases of the medulla and its neighbourhood disturb the action of the heart or the respiratory processes, when vomiting is produced by cerebral or spinal disease, when diabetes or polyuria are induced by irritations of the fourth ventricle. Such effects, again, are illustrated by the flow of tears under the influence of grief, by the arrest of the salivary secretion under the influence of fear, or by the occasional production of an increased flow of the same fluid at the thought of savoury food. Or, the action of the two nervous systems upon one another may take place in an opposite direction, as when in a neurotic subject an irritant in the intestine, or the passage of a renal calculus down the ureter, gives rise to convulsions; when forms of 'reflex' paralysis are produced; when the 'spirits' are depressed under the influence of visceral disease, sometimes to such an extent as to induce melancholia; or when, on the other hand, irritative states of the ovary lead to that form of insanity known as nymphomania.

Sympathetic disturbances are also apt to show themselves in the functions of certain parts comprised within the sphere of the cerebro-spinal system itself, when some other portion of it becomes the seat of disease, though the extent to which this occurs is still involved in much doubt. Brown-Séquard believed that hemiplegia itself is often induced by an 'inhibitory' influence, emanating from some morbid portion of the brain and acting upon certain motor-cells in the spinal cord. Similarly we find an irritation occurring in one portion of the organic nervous system entailing morbid manifestations in some other and perhaps distant part of this system, as when the early stage of pregnancy or when ovarian or uterine disease leads to vomiting; when certain irritations of the stomach excite the act of coughing; or when irritations of the bronchial mucous membrane lead to vomiting. Essentially similar phenomena are seen when suprarenal-capsular disease leads to sick-

ness; or when a blow on the epigastrium, by conveying a shock to the semilunar ganglia, causes an arrest of respiration or of the heart's action. *See* SYMPATHETIC SYSTEM, Disorders of.

This tendency to the establishment of sympathetic or related disturbance of distant parts in local diseases of the nervous system, is one of the principal sources of the great complexity of diagnosis in these affections. Thus, though a lesion in the brain may give rise to a certain set of *direct* effects, the consequences of the same lesion may also, and mostly do, become multiplied by a reverberation of impressions throughout the nervous system. In this way what are called *indirect* effects are produced. Such indirect effects may show themselves either in the direction of arrest or of exaltation of function, and in the former case they are often said to be brought about by 'inhibition.'

The proportion between the direct and the indirect effects resulting from an injury to nervous tissue varies greatly in different cases, according to the seat, the extent, and the nature of the lesions, as well as according to the age, sex, and general health of the patients. Hence it often happens that the same kind of lesion seems at different times to give rise to a different set of clinical accompaniments.

In regard to *diseases of the organic nervous system* our knowledge is at present extremely defective. The recognition of the diseases of this system—that is, as diseases having such or such a pathological starting-point—is beset with peculiar difficulties. This is in part attributable to the free connections existing between the organic and the cerebro-spinal nervous system, and the consequent difficulty, so frequently arising, which opposes itself to our settlement of the question, as to whether any particular group of symptoms, possibly due to some primary disease of a portion of the organic nervous system, really owns such a cause, or whether it is rather due to some disordered condition of the cerebro-spinal centres, which induces indirect effects on the side of the nervous system of organic life. Then, again, in other cases, disease of some portion of the organic nervous system may really exist, which, by reason merely of our present defective physiological and pathological knowledge, remains unsuspected as a disease having that particular nature and origin.

The nature of the functions performed by the organic nervous system sufficiently explains this difficulty. In part it serves to link the functional activity of certain viscera with sensory impressions or motor acts referable to the cerebro-spinal system, as in the processes of ordinary or disturbed respiration, parturition, &c.; in part also it brings different organs into co-ordinated activity, as when the presence of food in the alimentary canal excites the simultaneous activity of the pancreas, the liver, and other glandular organs. And how well such functions as those last-named are performed we are often only able to estimate vaguely, if at all, since the actions of those portions of the nervous system on which they depend do not reveal themselves either by sensible impressions, or by movements of parts of which we are conscious.

Other functions of the 'sympathetic' nervous system, such as those which have to do with the maintenance and regulation of the functional activity of the blood-making or ductless glands, namely, the liver, the spleen, the supra-renal capsules, or the lymphatic glands, are even still further beyond the pale of recognisable phenomena. Yet disturbances of these purely organic functions may give rise to certain general affections, which we are unable to refer to morbid states or actions of this portion of the nervous system. Suprarenal-capsular disease, leucocythæmia, diabetes, chlorosis, various forms of anæmia and other conditions of general malnutrition, are instances of diseases possibly due to deficient or perverted action of some of these blood-making organs, immediately occasioned by morbid conditions of the sympathetic nerve-centres in relation therewith. And it may be fairly presumed that the functional activity of these organs is influenced by the nerves and nerve-centres with which they are in connection —just as that of ordinary secretory glands (such as the parotid and sub-maxillary) is known to be under the influence of the nerves with which they are supplied.

The true pathology of such general diseases as have been named, we may hope will be ultimately elucidated by the application of the same means as have led to our present knowledge concerning the symptomatology of local diseases in the cerebro-spinal portion of the nervous system. This means, therefore, would consist in a more searching and habitual examination of the several parts of the nervous system of organic life, so as to endeavour to connect morbid appearances in its several centres with appreciable pathological states of ductless and other organs, and the still further endeavour to colligate these morbid appearances with the respective states of health or symptoms exhibited by the patients during life. Slow and difficult as this method is, it is the only one (apart from the experimental method with lower animals, which is here available only to a very limited extent) that would appear to hold out any probability of ultimate success.

The obscurity prevailing in reference to diseases of the *cerebro-spinal nervous system*, is not to be compared in extent with that relating to the nervous system of organic life. The reason of this is obvious. Deviations from its proper functions come much more easily under the ken of the physician and of the patient; whilst, in addition, morbid changes in this part are a few degrees less difficult to detect, and as they are situated in parts which are also much more frequently scrutinised in the *post-mortem* room, such changes are in reality far more frequently recognized than when they occur in one or other of the more scattered centres of the nervous system of organic life.

For some general remarks on the diseases of the cerebro-spinal nervous system, the reader is referred to the articles, BRAIN, Diseases of; and SPINAL CORD, Diseases of.

ÆTIOLOGY AND PATHOLOGY.—The proper and well-balanced working of the nervous system, as a whole, depends upon the maintenance of the accustomed degree of excitability in its different nerve-centres; and the proper nutrition of such

centres, upon which their normal molecular mobility depends, is certainly largely dependent upon their habitually receiving a supply of blood which is definite in amount, and uniform in quality. But the amount of blood going to any tissue or part is subject to the regulating influence of the local vaso-motor centre, with which the vaso-motor nerves supplying the blood-vessels in question are in relation. By the influence of other parts of the nervous system, or owing to the condition of these vaso-motor nerve-centres, the vessels dependent upon them may be either unduly contracted, or unduly dilated. Again, the proper quality of blood is subject to much alteration in different diseases; for instance, it may be thin and poor in anæmic states, it may contain poisonous ingredients in workers with lead and mercury, whilst it may contain varied noxious constituents in those suffering from grave renal disease, from septicæmia, and from the acute specific fevers. In this latter group there is, however, reason to believe that some of the abnormal nervous phenomena which are apt to manifest themselves may be due, not so much to the direct toxic influence of altered blood, as to the fact that in such states of the system the blood may be, at times, more prone than natural to coagulate in the minute vessels of the nervous system. Such undue proneness to coagulate sometimes depends upon the existence of an increased number of white blood-corpuscles, which, either from the state of the blood-plasma, or from the condition of the tissues outside, show a more than usual amœboid activity. Or an undue proneness of the blood to coagulate in some of the small vessels of the nervous system, during or after some of the acute specific diseases, may be due to an unnatural tendency of the fibrin to separate from such altered blood. The nutritive changes taking place in different tissues are chemical changes, differing from one another in exact nature, and therefore capable of reacting differently upon the blood circulating through such parts. These facts suffice to show how difficult it is to draw the line between what are probably mere toxic effects of an altered blood, and those which are due in the main to minute and almost inappreciable changes in the condition of the smaller blood-vessels of a nerve-centre.

But whenever variations take place in the nutritive condition of any centre, these variations are apt to involve not only an altered action in that particular part, but a perverted functional activity of other related parts. It often happens, therefore, that an exaltation or diminution of functional activity in some one part of the nervous system, causes a diminution, exaltation, or other perverted activity in distant parts of the system. Thus, owing to the many possible permutations and combinations, we may get the most varied grouping of abnormal phenomena traceable to altered actions in the nervous system, and having for a starting-point some perverted functioning of one or more nerve-centres. We have here the mode of production of what are commonly called *functional diseases*. Diseases of this type are specially apt to manifest themselves after some unusual strain has been thrown upon the nervous system, especially if the general health was at the same time lowered. The strain may have arisen from prolonged over-work and deficient sleep, or from some sudden mental shock, whether of joy or terror, but more especially the latter. At other times such functional diseases appear without any assignable cause, more especially in persons of a neurotic habit of body. Great differences exist amongst different individuals in this respect, that is, in their proclivity to diseases of the nervous system, though it is a matter of common observation that children and females are, as a rule, much more prone than men to become affected by nervous diseases of this type.

It is now a well-established fact that persons who are endowed with a neurotic habit of body, very frequently *transmit* a similar tendency to their children. It is not a tendency to any one particular disease, but a vulnerability of the nervous system as a whole which is transmitted, so that under the influence of even a comparatively slight strain, this weakness may manifest itself in one or other of various ways. It may reveal itself by mere general nervousness or tremors, by attacks of chorea, by epilepsy, or by one or other of the forms of insanity. When the neurotic habit of body exists to a well-marked extent—either in one or in both parents, different children may be affected in several of these modes; yet it is not necessarily so, for the inherent vigour of some of their progeny may cause such tendencies to be dwarfed and practically blotted out.

Other diseases of the nervous system are induced by definite and easily recognisable structural changes belonging to one or other of the following varieties. Rupture of blood-vessels often happens, causing *hæmorrhage* either into or upon the brain or spinal cord; though hæmorrhage into the latter organ is an extremely rare event. Or changes may occur in the vessels of some part of the nervous system, leading to their narrowing or actual occlusion by the combined influence of degenerations and thrombosis; or a similar result may be brought about by the lodgment of an embolus, and in each case the consequence, if the patient live long enough, is the establishment of a focus of *softening* in the brain or spinal cord. In addition to these changes we have others of an irritative or *inflammatory* nature. These may affect the surface of the brain, when they are associated with *simple* or with *tubercular meningitis*; or they may implicate some deeper portion of its substance, though unfortunately we are at present only very imperfectly able to separate these inflammatory affections from the more simple degenerative softenings, either at the bedside or in the *post-mortem* room. If, however, the inflammatory focus should subsequently become the seat of an *abscess*, the latter difficulty would disappear. In the nerve-trunks an inflammatory condition, affecting principally their connective-tissue envelopes, is not unfrequently met with, and goes by the name of *neuritis*. Again, *tumours* may be found, either arising in or pressing upon some portion of the nervous system. These may have been produced under the influence of scrofulosis or syphilis, or they may be cancerous, or wholly unrelated to any general diathetic state. *Acephalocysts* or *cysticerci* are also occasionally

met with pressing upon the surface, or within the substance of the brain; or fluid may accumulate within the ventricles, as in *hydrocephalus*. But a far more frequent morbid condition consists of an overgrowth of the interstitial connective tissue, leading to the formation of patches or tracts of *sclerosis* in the brain and spinal cord. This change constitutes the basis of several well-recognised morbid conditions of a progressive type. Lastly we may have certain special forms of *atrophy* and *degeneration*, showing themselves more especially in the nerve-cells of various parts of the brain, spinal cord, or sympathetic ganglia.

Treatment.—For the treatment of nervous diseases we have at our disposal a number of invaluable remedies, whose action is more or less special. Thus, we have strychnine and bromide of potassium, possessing the opposite properties of increasing and diminishing the reflex excitability of the nervous system, in addition to other beneficial modes of action. We have chloral and morphia acting either directly or indirectly as hypnotics, and thus allowing the curative action of rest to come into play. We have opium and Indian hemp, subcutaneous injections of morphia, and the constant galvanic current as pain-subduers. We have drugs like ergot and nitrite of amyl, capable of influencing the calibre of the smaller arteries. We have in conium and chloroform most powerful agents for relaxing the whole muscular system. We have iodide of potassium, which in syphilis and other cachectic states of the system seems to act as a direct antidote for the dispersion of connective-tissue overgrowths. Whilst in the various forms of electricity we have special agents of the highest value, not only for mitigating pain, but for allaying spasm, for improving the nutrition of wasted muscles, and for facilitating the bringing of them again under the influence of the will in cases of paralysis.

The above are only some of the chief special remedies which we employ in the treatment of nervous diseases. We have, as more general remedies—so-called nervine tonics—the preparations of zinc, arsenic, iron, quinine, phosphorus, cod-liver oil, &c.; whilst we have also frequent occasion to call to our aid ordinary tonics, purgatives, emmenagogues, anthelmintics, and counter-irritants, together with cold or tepid douches and the shampooing of paralysed limbs.

The manifestations of nervous disease are immensely influenced by the general state of health of the patient, and this not only in so-called functional, but even in the gravest of structural diseases. There is indeed no class of affections in which more good may result from a minute regard to diet, exercise, amount and kind of labour, and that general attention to all hygienic details upon which those most skilled in the treatment of these diseases always largely rely. There are few chronic diseases of the nervous system, even of the most obstinate and progressive type, in which very much may not be done either to arrest or to stay their progress, by careful attention to such hygienic details, by the judicious administration of drugs, and by maintaining the general health of the patient at the highest possible standard.

H. Charlton Bastian.

**NERVOUS TEMPERAMENT.** *See* Temperament.

**NETTLE RASH.**—A popular synonym for urticaria. *See* Urticaria.

**NEUCLEUS.**—*See* Cell; and Appendix.

**NEUENAHR, in Germany.**—Thermal alkaline waters. *See* Mineral Waters.

**NEURALGIA** (*νεῦρον*, nerve, and *ἀλγέω*, I suffer pain).—Synon.: Fr. *Névralgie*; Ger. *Neuralgie*.—This is a term applied to a disease of the nervous sensory apparatus, marked by paroxysmal pain, which is for the most part unilateral, and in the course of nerves. In many cases no evidence of change in the periphery of the nerve is discoverable, and to these the term *neuralgic* is perhaps most properly applied; in others, however, there is reason to think that inflammation of the sheath of the nerve is at least the starting-point of the disorder. The diagnostic points are as yet not sufficiently certain for these cases of peri-neuritis to be absolutely separated from those of neuralgia, and they may so far be considered together. Relative constancy in the pain, with paresis and atrophy of muscles supplied by the affected nerve, and swelling of the nerve-trunk, point to peri-neuritis. *See* Neuritis.

Ætiology.—Neuralgia is prone to occur in families marked by neurosal tendencies, not necessarily of neuralgic character, but which display themselves in various phases of psychical disturbance, as insanity, hysteria, hypochondriasis, or in the shape of epilepsy and chorea. Rare before puberty, that crisis has a strong predisposing influence. In the middle period of life, though first attacks are not very common, revivals of old-standing disease are apt to occur, as a result apparently of the depression occasioned by the cares of life. Premature agedness (marked by atheromatous changes in the vessels, arcus senilis, permanent greyness of hair, bagging of the cheeks, pulmonary emphysema) conduces to severe and intractable neuralgias. Malaria is a potent cause. Anæmia and mal-nutrition generally, however brought about, play an important part. So also do sexual excesses, and perhaps likewise a state of celibacy. Pregnancy, over-lactation, and menorrhagia are each predisposing causes. The most frequent exciting causes are cold, especially damp cold; injury to the nerve by violence, or by the encroachment of morbid growths; syphilis; gout; and the presence of lead or mercury in the system. Irritation of peripheric organs may excite neuralgia in nerves nearly or remotely associated. So dental caries may induce supra-orbital neuralgia; uterine disease may excite neuralgia of distant nerve-trunks—as, for example, the occipital; and the presence of intestinal worms may explain the occurrence of neuralgia in parts quite unconnected with the bowels. Neuralgia is a common sequel of relapsing fever.

Anatomical Characters.—In neuralgia proper no definite lesions are discoverable — at least, none that are constant enough to deserve the place of necessary accompaniments or factors of the disease. As a result of neuritis or peri-

neuritis the nerve-trunk is sometimes found swollen and hyperæmic; or, in a later stage, it may be atrophied and its fibres degenerated.

Symptoms. — After some little preceding numbness, cutaneous anæsthesia, or other abnormality of sensation, the import of which gets to be well understood by persons liable to neuralgia, the patient is seized with pain, which at first is not severe, and ceases quickly, but returns in a few seconds or minutes, lasting for a short time, and then remitting. These darts revive with shorter and shorter intervals, so that in a little time the pain appears to be almost continuous, or interrupted only by waves of intensity, and it will last for some seconds or more than a minute together. Then comes a respite, to be followed by recurrence, and these alternations may continue for a few minutes or as many hours. In attacks of long duration where no treatment is applied, the pains gradually get less acute, the intermissions longer, and the outbreak slides off into a confused feeling of discomfort and bruising about the seat of pain, coupled with a sense of exhaustion and desire for sleep. The character of the pain varies; it is described as darting like a knife or like lightning, crushing, hammering, boring, and sometimes burning. In neuralgia about the head the patient will often be seen to cringe and recede before the plunges of pain, as though he were receiving blows. When the pain is at its worst there is often a radiation of it to other nerves, and especially to those placed symmetrically with the one affected; but this secondary pain never attains anything like the severity of the original. Not always, but very commonly, certain definite points where pressure is exceedingly painful may be found by palpation. These, the '*points douloureux*' of Valleix, have a certain diagnostic importance. Rare in first attacks, they are much more common in patients who have been subject to recurrences during many years. There is always a nerve-branch under the skin at these points, and more often than not they correspond with the point of emergence of a nerve from a bony groove or opening, or its passage through a muscular aponeurosis. Pallor of the skin, followed by intense redness, horripilation, and other evidences of vaso-motor disturbance are common. In the case of nerves being attacked which preside over glands there is often increased secretion. The tactile sensibility of the skin is almost always diminished after a time in the neighbourhood of the affected nerve, though at first there is some hyperæsthesia.

Local Varieties.—The varieties of neuralgia are divided into two primary groups, namely, I. **Superficial**; and II. **Visceral**.

I. **Superficial**.—These include the following:—

(*a*) *Trigeminal neuralgia*. *See* Tic Douloureux.

(*b*) *Cervico-occipital neuralgia*.—The posterior branches of the first four pairs of spinal nerves may be affected, but it is that of the second, the great occipital, which is most important, from its size, and the frequency with which it is attacked. Shooting pains start from just below the occiput, and run over the back and top of the head, sometimes into the external meatus, and often to the front of the head and face. Giddiness, noise in the ears, and some confusion of ideas are often associated, and frequently cause cervico-occipital neuralgia to be mistaken for commencing organic disease of the brain. It may begin by such acute tenderness of the scalp as makes it an agony to brush the hair.

(*c*) *Cervico-brachial neuralgia*.—The nerves of the brachial plexus and the posterior branches of the four lower cervical nerves are here concerned. The pains affect the neck and shoulders, or shoot down the arm to the hand, in the course of one or more of the nerve-trunks. Painful points may be found in the axilla, over the upper part of the deltoid, at the bend of the elbow, three inches above it externally, in the groove between the inner condyle of the humerus and the olecranon, at the ulnar side of the annular ligament, and where the radial nerve becomes superficial. The ulnar nerve is that most often affected, but the neuralgia usually spreads to other trunks. This form of neuralgia is sometimes associated with the presence of carious teeth.

(*d*) *Dorso-intercostal neuralgia*. *See* Intercostal Neuralgia.

(*e*) *Lumbo-abdominal neuralgia*.—Here the superficial branches of the lumbar plexus to the abdominal walls are affected. It is less common than intercostal neuralgia, but resembles it generally. Tender points may be found close to the spine, at the middle of the crest of the ilium, in the hypogastric region, in the groin, and on the scrotum. The female sex is apt to be most affected.

(*f*) *Crural neuralgia*.—This variety is almost always met with as a complication of sciatica, being rare by itself. Pain occurs in the front of the thigh and knee, and inner surface of the leg and foot. The long saphenous branch of the anterior crural nerve is most commonly affected. This form of neuralgia is not unfrequent in hip-joint disease, where it is secondary to irritation of the branches of the obturator nerve supplying the joint.

(*g*) *Obturator neuralgia* affects the inner side of the thigh.

(*h*) *Femoro-popliteal neuralgia*. *See* Sciatica.

(*i*) *Coccydynia*.—Pain in the neighbourhood of the coccyx, more properly called *coccygodynia*, especially apt to occur in women, is sometimes, but by no means always, due to neuralgia of the coccygeal plexus. The pain is felt particularly in sitting, and shocks from rapid movement or jumping will cause great distress. So also sometimes the act of defæcation may be so painful as to suggest the presence of fissure of the anus. More often than not the affection follows an injury, especially a fall in the sitting position, and happens sometimes after difficult parturition.

II. **Visceral**.—(*a*) *Cardiac*.—A certain portion of the class of cases called angina pectoris depends upon cardiac neuralgia (*see* Angina Pectoris). There is sudden severe pain at the lower end of the sternum, darting to the back and down the left arm, or it may be diffused over the chest and affect both arms. The heart

feels as though it were grasped, the face loses colour, the pulse becomes altered in character, there is cold sweating, and generally the aspect and feeling of approaching death. Such attacks may be confined to two or three repetitions, or there may be a constant tendency to their recurrence under circumstances of fatigue or strong emotion.

(*b*) *Uterine and ovarian neuralgia.*—Pain attendant upon menstruation, independent of any mechanical difficulty, is thus named. It may be excited by such sources of peripheral irritation as ascarides, leucorrhœa, renal calculus, prolapsus uteri, tumours, ulceration of the cervix, or impaction of fæces; or the sources may be in some distant part of the body. Ovarian neuralgia may be accompanied by congestion of the ovary.

(*c*) The *urethra*, *bladder*, *rectum*, *kidney*, and *testis* may each be affected by neuralgia. The latter may result from self-abuse, or be consequent upon renal concretion. *See* Nephralgia.

(*d*) *Gastralgia.*—Abdominal neuralgia is characterised by intensity of colicky pain, occurring in paroxysms in circumstances differing from those which induce ordinary dyspepsia. There is nearly always a history of neuralgia in some other part of the body. Vomiting sometimes, and constipation invariably, accompanies the attacks. *See* Gastralgia.

Complications and Sequelæ. — Neuralgia when it attacks mixed nerves may produce muscular powerlessness, which is not merely a shrinking from making muscular effort because of the pain attending it, but a temporary paralysis. Or there may be spasm of muscles. Long-continued neuralgia is attended by more or less atrophy of the muscles supplied by the affected nerves, which may be temporary, or, in cases where frequent recurrences of the attack take place, may be permanent. Certain forms of neuralgia, especially that of the first division of the fifth, intercostal, and sciatic are liable to be accompanied by a herpetic eruption (*see* Herpes). Anæsthesia of a portion of the skin will often persist, though the pain itself may be absent.

Diagnosis.—It may be said perhaps that for pain to be strictly accounted *neuralgic* there should be no obvious cause for it, such as local inflammation, tumour, or injury: it should be intermittent, or at least liable to great exacerbations, and independent of movement or any external agency; it should take the course of one or more nerves; and there should be spots painful to pressure in some of the localities already indicated. Neuralgia is distinguished from myalgia by the latter involving the attachments of a muscle, not occurring in paroxysms, but dependent upon movement; from aneurism by careful physical examination, which is especially necessary when the pain is about the chest and loins. In chronic rheumatism the pain is diffused, influenced by movement, and it does not affect the district of a particular nerve. Acute rheumatism is accompanied by elevation of temperature, sweating and swelling of joints. The thermometer, and the known symptoms and signs of the several diseases, will also at once exclude pleurisy, pneumonia, and peritonitis. Syphilitic periostitis is evidenced by the sight and touch, as well as (if it occur early in the disease), by the presence of febrile movement. Where pain in the back is supposed to be of neuralgic origin it is important to exclude the presence of hernia. Examination should be made *per vaginam* to exclude flexions or tumours of the uterus, and *per anum* for the presence of abscess about the rectum or malignant disease. Organic disease of the brain must be excluded by the absence of local palsy, vomiting, intellectual disturbance, or optic neuritis. The pains of Bright's disease must be carefully excluded by search for albumen, signs of arterial thickening, and cardiac hypertrophy. Spinal irritation is accompanied by pains which, however, fail to mark the district of particular nerves, and are vague and shifting. There is hyperæsthesia of the skin over some of the vertebral spines. Locomotor ataxy is characterised by pains of lightning-like rapidity, and neuralgic in character; but they shift, are often accompanied by a staggering gait, sometimes by diplopia. Absence of the patellar tendon reflex (the quadriceps extensor muscle at the same time responding freely to faradization and blows) is a strong indication of locomotor ataxy. The pains of syphilis in its second stage may be distinguished by the presence of fever, usually also of a rash, and the fact that they affect many parts at once.

Prognosis.—Youth, the absence of strongly-marked history of hereditary neurosis, the fact that neuralgia has followed exposures to unusual strain, severe weather, or passing defects of nutrition, and that its attacks are influenced readily by treatment, afford a favourable prognosis. The onset of the disease after middle life, and its concurrence with signs of arterial degeneration, are unfavourable as regards cure. Neuralgia of itself can scarcely be said to affect the duration of life. On the whole neuralgia of the fifth nerve is the most persistent.

Treatment.—In patients suffering from malnutrition the diet should be ample and nutritious, and should include a fair amount of the fatty element, in the form of cod-liver oil, butter, or cream. A little stimulant may sometimes be necessary, enough to promote primary digestion, but no attempt should be made to relieve pain by its direct agency. Rheumatism should be treated by salicylate of soda in 20-grain doses three or four times a day. Two or three grains of iodide of potassium with fifteen of carbonate of soda taken every four hours will often remove neuralgic pain connected with rheumatism. When malaria is suspected it is well to follow up this treatment by quinine in doses of from five to ten grains twice a day. A mercurial purgative may be usefully combined with a dose of quinine. If there be syphilis, iodide of potassium in 10-grain doses three times a day must be had recourse to; if gout, the acetic extract of colchicum may be given in one-grain doses twice daily, coupled with saline purgatives. Even where there is no history of malaria quinine will often be very useful, especially in neuralgia of the first division of the fifth (*see* Tic-Douloureux). Phosphorus in its free state, in capsules containing $\frac{1}{30}$ gr. twice a day, after food, is sometimes of service. Or the hypophosphite of soda or potash may be

given in doses of from five to ten grains. Phosphoric acid is not of value. The liquor potassæ arsenitis, in doses of ♏iij, increased cautiously to ♏viij, or ♏x, and the tincture of steel, in doses of ♏xxx, largely diluted with water, may sometimes be used with advantage; and the latter will occasionally succeed even when there are no ordinary signs of chlorosis. As anæmia may exist with a well-coloured face, the state of the gums and inner surface of the lower eyelid should be examined for undue pallor. Strychnia, in ♏iij to ♏v doses of the liquor three or four times daily, is especially useful in gastralgia, and belladonna, in ¼ gr. doses of the extract or ♏x doses of the tincture, in neuralgia of the pelvic viscera. Seclusion from irritation of various kinds—movement, cold, noise, dazzling light, worry—should be carefully maintained in cases of trigeminal neuralgia. All sources of peripheral irritation, of which decayed teeth, foreign bodies under the skin, intestinal worms, imperfectly-fitting boots are examples, should be carefully searched for, and where practicable removed. If lead be suspected the drinking water should be tested, and if the mineral be found iodide of potassium may be administered. Removal from imperfectly ventilated rooms, or from exposure to noxious gases, is essential. A warm, dry climate, such as Egypt or Algeria, will often cure when all other remedies have failed. For immediate relief morphia may be injected hypodermically, either near the seat of pain, or in an indifferent part of the body. It is best used pretty freely diluted, ♏iij of a solution of acetate of morphia, 1 to 30, being commenced with, and repeated, if necessary, when the pain returns. This dose may be gradually increased to one of ♏xv, but an effort should be made to do with as little as possible and to avoid narcotic effects. The following pill is often useful: ℞ Quiniæ gr. j, Ferri Tartarati gr. ij, Morphiæ Acetatis gr. $\frac{1}{12}$, repeated every hour or two when the onset is expected.

Next in value to morphia is the use of small blisters (size of a florin), applied in the neighbourhood of the principal focus of pain, one following another at intervals of two days, not on but near the already blistered surface. The continuous current, derived from so many cells of a battery as cause a characteristic feeling of burning, may be so applied that the affected nerve is as completely as possible included in the voltaic circuit. Sponges moistened with warm salt water should convey the current, and be kept firmly pressed upon the skin for about ten minutes; or, whilst one is still, the other may be slid along so as to linger in turn upon each focus of pain. To avoid shock the circuit should not be broken by the lifting of a sponge till the battery is 'let down' to zero. If relief be afforded the application may be repeated many times a day. No notice need be taken of the position of the poles (+ and −), the object of the proceeding being simply to alter the electric tension of the tissues which are made to form part of the circuit.

In rare instances, but especially in ovarian neuralgia, the hypodermic injection of atropine ($\frac{1}{120}$ gr. to $\frac{1}{60}$ gr. of the sulphate) may prove serviceable. Where there is great restlessness and irritability of the nervous system, bromide of potassium in 30-grain doses two or three times a day should be used. Relief, in slight cases of neuralgia, is obtained by applying to the skin such liniments as the following: ℞ Chloroformi ℥ss, Tincturæ Opii ℥ss, Linimentum Belladonnæ ad ℥iij.; or ℞ Spiritus Ammoniæ aromatici, Ætheris, Tincturæ Opii, Spiritus Vini rectificati āā ℥j. Aconite and veratria benumb the sensory nerves, but they are uncertain remedies and very apt to cause irritation.

In unusually severe cases, which have lasted over years, a portion of the nerve may be excised; or, what is better, the nerve, which has been exposed by an incision, may be lifted from its bed and so firmly pulled upon as to be stretched (*see* Nerves, Diseases of). Very satisfactory results have followed this procedure. In a case, treated by the writer, of terribly severe neuralgia of the first two divisions of the fifth nerve, the operation was performed on each division of the nerve in turn, with immediate and, as far as at present observed, permanent relief from pain. Some time after the cure of a neuralgia there may be threatenings of a revival (dull heaviness, with tenderness, of the part) following great fatigue or worry, but not immediately amounting to anything. Sleep is the best remedy for this condition, and this, if necessary, may be aided by giving ten grains of chloral hydrate.

Special reference must be made to the treatment of coccydynia. This consists in subcutaneous division of the muscles and fibrous structures attached to the coccyx with a tenotomy knife. In very troublesome cases the coccyx has been excised. The application of a leech or small flying blisters in the neighbourhood, will sometimes relieve. The bowels should be kept rather loose, and rest enjoined. In obstinate cases, where it seems probable that local irritation exists, the above-mentioned operation of Sir J. Simpson may be performed with advantage.

T. Buzzard.

**NEURITIS** (*νεῦρον*, a nerve).—Definition. Inflammation of a nerve.

Ætiology.—This process occurs sometimes as an idiopathic change, whose origin is altogether obscure, as where it implicates some of the intercostal or other spinal nerves, and is then often associated with an eruption of *herpes zoster* in corresponding regions of the skin. At other times, as in some of the cases when it attacks the facial especially, or the sciatic nerve, neuritis seems to be set up as a result of local exposure to cold (*see* Facial Nerve, Paralysis of; and Sciatica). Such forms of neuritis as these are commonly spoken of as 'rheumatic inflammations' of the respective nerves. Sometimes this appellation may be distinctly justified; but whether such changes have necessarily to do either with rheumatism or with a rheumatic predisposition—or, indeed, with gout—seems in many cases fully open to doubt. A process essentially similar does, however, unquestionably occur with especial frequency in connection with the roots of cranial or spinal nerves, in persons affected with syphilis.

At other times neuritis may be of traumatic

origin, or it may spread along the nerves leading from some wound or sloughing sore. This latter condition of things has been found to exist in some cases of traumatic tetanus. *See* TETANUS.

ANATOMICAL CHARACTERS.—Strictly speaking, we have to do, in this pathological state, with inflammation of the sheath of the nerve, rather than with changes in the nerve-fibres themselves. It is possible, of course, that the nerve-fibres in this condition may undergo some distinctive pathological changes, but what is at present known is, that the neurilemma, or connective-tissue sheath of the nerve (including its minute prolongations between and around separate bundles of nerve-fibrils) becomes much more hyperæmic than natural, and that on microscopical examination there is to be found, in addition to the increased vascularity, a multiplication of new tissue-elements and the presence of migrated leucocytes. These changes may cause considerable swelling of the nerve-sheath and of its prolongations, and thus may produce either mere irritation or more or less compression of the nerve-tubules, according to the amount of new elements which accumulate in or are produced within the nerve-sheath.

SYMPTOMS.—The symptoms of neuritis will necessarily vary much according to the functions with which the affected nerve is concerned. There may be impairment of special or common sensibility, or pain may exist (referred to the peripheral distribution of the nerve), with more or less distinct tenderness along its course. In these cases the pain is generally paroxysmal, and possibly a pustular or vesicular skin-eruption may present itself along the course of the nerve, after some more than usually severe attack of pain. Where a motor nerve is implicated, there may be twitchings of the muscles to which it is distributed, followed, perhaps, by more or less distinct paralysis. In the case of a mixed nerve, like the sciatic, being involved, both kinds of symptoms present themselves—that is, more or less severe pains and tenderness, together with a distinct paresis of the muscles to which the nerve is distributed.

TREATMENT.—The treatment of neuritis is both general and local. The general treatment is of especial importance in cases where the condition seems attributable to the influence of syphilis, and then the administration of small doses of bichloride of mercury, in combination with large doses of iodide of potassium, will often produce marvellously beneficial results. Smaller doses of iodide of potassium alone, or with colchicum, are to be given in other cases, in which rheumatism or gout may seem to be one of the factors in exciting the nerve-inflammation. But in these cases, and also in those which are simple results of exposure to cold, the cure may be often expedited, and the patient also temporarily relieved, by local treatment, such as the application of a leech or two (especially in the early stages), hot fomentations, or small flying blisters.

During the course of the treatment special symptoms may become all-important; thus, pain may become so agonising as imperatively to demand measures for its relief; and, where paralysis is one of the symptoms, galvanism must be employed daily, or two or three times a week, in order to prevent as much as possible the muscles from degenerating whilst the pathological condition in the nerve is being cured—that is, in cases in which a cure is possible.

H. CHARLTON BASTIAN.

**NEUROMA** (*νεῦρον*, a nerve).—A tumour connected with a nerve. *See* NERVES, Diseases of.

**NEUROSES** (*νεῦρον*, a nerve).—SYNON.: Fr. *Névroses*; Ger. *Nervenleiden.*

DEFINITION.—Affections of the nervous system occurring without any material agent producing them, without inflammation or any other constant structural change which can be detected in the nervous centres: in other words, functional affections of the nervous system.

Many of the disorders which may be included here are characterised by symptoms such as neuralgia, convulsions, &c., which also accompany other disorders associated with morbid changes. It is very necessary, therefore, in inquiring into any particular case not to rest satisfied with the presumption that the disorder is functional until the condition of the nervous centres has been investigated; lest, regarding the symptom as the disease, the central mischief to which it is due may be overlooked. It is highly probable, moreover, that many of what we now regard as functional diseases will, on further investigation, be found to depend upon some corresponding change in the organ affected.

ENUMERATION.—The neuroses may be classified according to the organs or functions involved:—

*a. Visceral Neuroses*, namely, those of the respiratory, circulatory, or digestive organs.

*b. Localised Paralyses*; for instance, palsy of the facial and other peripheral nerves.

*c. Localised involuntary or reflex movements*, such as spasm of the facial nerve, and writer's cramp.

*d. Disorders of general sensibility*, including the various forms of neuralgia—trigeminal, cervico-occipital, sciatic, crural, &c.

*e. General Neuroses*, namely, chorea, tetanus, epilepsy, catalepsy, hysteria, and allied affections.

*f. Disorders of the mental faculties*—hypochondriasis, melancholia, and other forms of mental derangement.

P. W. LATHAM.

**NICE, on the French Riviera.**—Fairly warm, rather variable and windy, dry, bracing winter climate. Mean temperature, winter, 46·33° Fahr. *See* CLIMATE, Treatment of Disease by.

**NICTATION** } (*nictito*, I wink often).
**NICTITATION** }
A rapid involuntary winking of the eyelids, usually due to some nervous disturbance. *See* CHOREA; and FACIAL SPASM.

**NIGHT-BLINDNESS.** *See* NYCTALOPIA.

**NIGHTMARE.**—This is a condition characterised by an abiding sense of discomfort or extreme uneasiness, occurring in the midst of a disturbed sleep, sometimes associated with a feeling of weight at the epigastrium, in conjunc-

tion with more or less definitely oppressive dreams. It is principally associated with the taking of a heavy meal or of indigestible food before going to sleep by some persons, especially those of a nervous temperament, whose digestion is weak. A closely allied condition is, however, apt to be met with as a consequence of brain-exhaustion and chronic disturbance of sleep in those who are overworked, either by application to study, business details, or literary pursuits. Such a condition also has its affinities with certain forms of incipient delirium, occurring either in various febrile diseases or as a result of alcoholic excesses. *See* SLEEP, Disorders of.

H. CHARLES BASTIAN.

**NIGHT-SIGHT.** *See* HEMERALOPIA.

**NIGRITIES** (*niger*, black).—SYNON.: Fr. *Noirceur*; Ger. *Schwärze.—Nigrities cutis* signifies blackness of the skin. It may be of various degrees; and results from aberration of deposit of pigment, or, more exactly, from an excess of black pigment in the integument. *See* MELANOPATHIA.

**NILE, The.**—Very dry winter climate. Unsuitable for cases of active pulmonary disease. Mean temperature, winter, 57° Fahr. *See* CLIMATE, Treatment of Disease by.

**NIPPLE, Diseases of.**—SYNON.: Fr. *Maladies du Mamelon*; Ger. *Krankheiten der Brustwarze.*—Some of the more ordinary affections of the nipple will be found described under BREAST, Diseases of, and LACTATION, Disorders of. Here it is proposed to treat of certain graver diseases, which claim a separate consideration.

**Malignant Disease.**—The nipple may be the seat of epithelioma, which commonly commences as a crack or fissure, with an indurated base, often in the areola or at its junction with the nipple. It presents no special features which distinguish it from similar disease of the integument of adjoining parts. Hard carcinoma too may attack the nipple, involving its deeper structures and producing general induration and enlargement, so that the diseased mass projects from the summit of the breast like a knob or large nut. The disease probably originates in the epithelium of the galactophorous ducts, or in that of the sebaceous glands.

Of greater interest than either of these is an affection frequently associated with malignant disease of the breast, to which Sir James Paget has lately drawn attention—an eczematous condition of the nipple and areola. It may occur in the form of a dry, scaly, or branny eruption, affecting the entire surface of the areola and nipple, which is darker-coloured, a little firmer, and less pliant and elastic than its fellow. Or, with more characteristic signs of inflammation, small vesicles or pustules may form, and, breaking or being rubbed off, may leave behind them tiny scabs or ulcers, or a surface raw and red. Either condition may exist for many months or even years with little alteration, and with scarcely any tendency to spread beyond the margin of the areola. But the second form, causing more irritation than the first, is often subjected to treatment, and being very difficult to cure, is sometimes so severely treated with caustics that destruction ensues, not of the disease, but of the nipple, which appears to have been gradually eaten away by the eczematous affection. Both forms are uncommon, but they are rare before the middle age. A study of their clinical and pathological characters leads to the conclusion that they are due to inflammation. The disease has been noticed in men as well as women.

TREATMENT.—This disease may be treated by protecting the parts with a carefully adjusted, ventilated shield, and by the application of vaseline, or liniment of lead and oil, or similar soothing dressing. But it is very intractable, in some cases apparently incurable. It might seem as if an affection so trivial were not worthy of so much attention; but unfortunately there appears the strongest reason to believe that these conditions of the nipple and areola are not infrequently the precursors of carcinoma of the breast, sometimes by only a few months, sometimes and more often, by a period of years. It is probable, too, that the carcinoma is directly due to the eczematous disease; for it induces changes in the epithelium of the ducts which can be traced deeply into the substance of the breast, whose acini become at length distended with proliferating epithelium. On this account it has been proposed, when all the lesser methods of treatment have been used in vain, to remove the entire breast. Opinions which are divided on the necessity of this measure, so severe, are united in its favour when, with the superficial inflammation, there exists an appreciable induration, however slight, within the breast. Care must be taken not to confound these eczematous affections of the nipple and areola with those more widely diffused surface inflammations of the breast, with which they have little in common, either in the obstinacy with which they resist treatment, or in the deeper disease to which they may give rise.

HENRY T. BUTLIN.

**NOCTAMBULATION** (*nocte*, in the night, and *ambulo*, I walk).—A term for sleep-walking. *See* SLEEP, Disorders of.

**NOCTURNAL EMISSIONS.**—Involuntary emissions of semen occurring during sleep. *See* SEXUAL FUNCTIONS IN THE MALE, Disorders of.

**NOCTURNAL INCONTINENCE.**—Involuntary escape of urine during sleep. *See* MICTURITION, Disorders of.

**NODE** (*nodus*, a swelling).—A circumscribed swelling on the surface of a bone, connected with the periosteum, and usually due to syphilis. *See* BONE, Diseases of; and SYPHILIS.

**NODI DIGITORUM** (Latin).—Swellings of the distal phalanges of the fingers, usually associated with gout. *See* GOUT.

**NOLI ME TANGERE** (Lat., Touch-me-not).—A term of dread, which has been applied to a state of severe ulceration of the nose, attended with fungous growth and more or less deformity. The phrase is subjective, and has been used somewhat indiscriminately in connection with lupus, cancer, and syphilis. It has now very properly fallen into disuse, or, when em-

ployed, is restricted to lupus exedens of the nose. *See* LUPUS VULGARIS. ERASMUS WILSON.

**NOMA** (*νέμω*, I devour).—SYNON.: Fr. *Nome*; Ger. *Wasserkrebs.*—A synonym for cancrum oris. *See* CANCRUM ORIS.

**NOSE, Diseases of.**—SYNON.: Fr. *Maladies du Nez*; Ger. *Krankheiten der Nase.*—The diseases that affect the nose may be conveniently divided into—(A.) The diseases of the **External Nose**; and (B.) the diseases of the **Internal Nose.**

A. **Diseases of the External Nose.**—

1. **Acne Rosacea.**—SYNON.: Pop. 'Gin-drinker's nose.'—This affection of the nose is generally met with in later adult age. Not unfrequently the cause is to be found in alcoholic indulgence. In other cases it may be associated with some irregularities of menstruation.

DESCRIPTION.—The organ is swollen and red; its surface is shiny and greasy-looking; the skin is highly injected, the venules particularly appearing almost varicose; the sebaceous follicles are enlarged, though not invariably; and the skin is hypertrophied, the whole condition giving rise to an unnatural protuberance. At a later stage of the disease the nose appears tuberculated and blotched, often pustular, and covered with crusts and scales (*acne hypertrophica*). The blood disappears under pressure, and increases under mental excitement.

TREATMENT.—Mild cases are best treated by lead lotion, a weak solution of the bichloride of mercury, or zinc ointment. In severe cases the subcutaneous division of the larger vessels by a fine tenotomy knife causes a rapid shrinking and improvement. In all cases of acne attention must be paid to the manner of living and general health of the patient.

2. **Boil, or Furuncular Inflammation.**—A very painful form of boil is liable to develop on the tip or alæ of the nose, causing great disfigurement and often intense suffering. It commences in the subcutaneous cellular tissue, or beneath the perichondrium; and by its gradual increase and extension to skin and fibro-cartilage, causes great swelling, tension, and throbbing pain, owing to the peculiar toughness of the tissues entering into the formation of the integumentary structures.

ÆTIOLOGY.—This affection is generally met with in young or middle-aged persons of intemperate habits, although frequently it is seen in the delicate and anæmic. Elderly persons, high feeders, who do not attend to the proper condition of their intestinal canal, are also liable to it.

TREATMENT.—If detected early, boil of the nose may be treated by painting with strong lead lotion, or just touching the part with the acid nitrate of mercury, and immediately rubbing it off. If very severe, and in order to avoid the pit or scar which might be left by allowing the disease to take its course, a very fine tenotomy knife may be passed through the nostril and into the boil, to relieve tension, and to allow of the escape of the pus into the nostril.

3. **Deformities.**—(α) *Congenital absence.*—Cases have been recorded of congenital absence of the nose. It does not appear that this condition can be satisfactorily assisted by surgical interference.

(β) *Congenital occlusion.*—Congenital occlusion of one or both nostrils is a very rare affection, and obviously must interfere seriously with sucking and respiration. It is either the result of a continuation of the integument, or is formed of fibrous tissue. The treatment, which should be undertaken at once, consists in making careful incisions through the obstruction, and keeping the nostril dilated with a piece of gum or metal catheter or a bougie for some weeks.

(γ) *Deviation of the septum.*—This deformity usually consists of a lateral curvature of the septum, and generally of some hypertrophy of its extremity, causing an inclination of the organ to one side or the other. As a result there is often great disproportion in the nasal cavities or nostrils, in some instances amounting to almost complete occlusion of one side; and the projection of the inferior turbinated bone of one side may be mistaken for a growth, on account of its protrusion. The treatment consists in carefully paring away the thickened septum, and subsequent dilatation of the nostril.

4. **Expansion of the Nose, Morbid.**—The tip occasionally becomes enormously developed, all the tissues being involved. This condition may require the removal of a wedge-shaped portion of the extremity, including the growth, and the subsequent adaptation of the parts.

5. **Fracture.**—In fracture of the nasal bones the displaced bone or bones should be raised, by introducing a pair of stout forceps with flat blades into the nostrils, guiding them up to the nasal bones by means of the septum, and then forcibly elevating them. The bones should be retained in position by plugs, or the small screw-clamp lately introduced, assisted in severe cases by some such mechanical appliance as a screw truss, passing round the head, and exerting pressure laterally upon the displaced bones. In cases of fracture of the septum with displacement, and subsequent deformity, the shape of the nose may be restored by this method, great attention being paid to the management of the plugs and clamp.

6. **Hypertrophy of the Integument.**—SYNON.: *Lipoma Nasi.*—This consists of a hypertrophied condition of the integuments and of the subcutaneous adipose tissue, constituting irregular fleshy excrescences, and occurring in cases of severe and old-standing acne rosacea.

DESCRIPTION.—The term 'lipoma' is an inappropriate one, inasmuch as the mass consists of hypertrophied infiltrated skin and cellular tissue, with enlarged sebaceous follicles, which occasionally become developed into distinct cysts and dilated veins. The growth is chronic and painless, varying very much in the degree of its development and appearance, sometimes scattered like small warts, at others pedunculated and lobulated, and often attaining an enormous size. It does not affect the cartilages.

TREATMENT.—The only treatment is removal by the knife, dissecting the mass carefully off the underlying cartilages, and allowing the surface to heal by granulation.

7. **Lupus.**—The forms of lupus attacking the nose are fully considered elsewhere in this

work. *See* Lupus Erythematosus; and Lupus Vulgaris.

8. **Malignant Disease.**—*Epithelioma* is a rare form of malignant disease in the nose. It commences with the characteristic wart, which passes on to the ulcerative stage; and its first appearance is either at the junction of the skin and mucous membrane, or in the membrane itself. It may be stationary for years, but ultimately ends in destruction of the organ. It must not be confounded with syphilis. The history of the case is often enough to establish the diagnosis; whilst the epithelial patch is nearly always single, and the specific multiple. The disease affects the glands sooner or later.

*Schirrus* and *Encephaloid cancer* occasionally involve the nose, generally growing from within outwards. These growths may be either excised, or destroyed by escharotics.

9. **Nævus.**—Nævus may exist in all degrees in the external nose, from the merest patch to a large disfiguring tumour. If very small, inoculation with vaccine matter may entirely destroy it. Ligatures invariably, if the growth be large, leave a scar; injection with perchloride of iron is very dangerous. The best method of treatment is the galvanic cautery; or in some instances the entire removal of the growth with the knife.

10. **Rodent Ulcer.**—Rodent ulcer is occasionally met with in the nose. It somewhat resembles lupus, but occurs in later life. The ulcer spreads gradually; and the pain is described as of a severe aching character. It has been classed with the cancers, but it lacks several of the characteristics of that kind of growth. There is no constitutional infection; and it has been abundantly proved that, if entirely eradicated with the knife, it need not return. *See* Rodent Ulcer.

11. **Sebaceous Tumours.**—Sebaceous tumours are occasionally met with on the sides and tip of the nose, and require removal.

12. **Syphilitic Disease.**—Syphilitic ulcers of the nose are of special interest as being one of the causes of ozæna. The symptoms and treatment of this condition are fully described in a separate article. *See* Ozæna.

13. **Wounds.**—Wounds of the integuments or soft parts of the external nose require the neatest coaptation, by the use of very fine silver wire sutures, or of isinglass plaster; and as union is generally very rapid, owing to the great vascularity of the tissues, unless this be attended to serious deformity may result. Any tendency to falling in of the nostril must be counteracted, by introducing a roll of lint or piece of bougie. It may be worth mentioning that instances have occurred where the nose has reunited after its complete removal from the face.

**Plastic Operations.**—Plastic operations on the nose, for the restoration of lost parts, or for the improvement of deformities, are described in works on operative surgery.

B. **Diseases of the Internal Nose.**—

1. **Anosmia.**—Anosmia, or loss of the sense of smell, when of traumatic origin, is either the result of injury, such as blows on the head, or of the inhalation of noxious vapour; or it depends on cerebral disease. In the former case, a very frequent cause is a blow on the head, probably rupturing some filaments of the olfactory nerves, as they pass through the cribriform plate of the ethmoid bone, according to Ogle (*Med. Chir. Trans.* vol. liii). The external root only of the olfactory nerve is the one directly concerned in olfaction, 'and it depends upon the degree to which this root or its central termination has been disorganised, whether the loss of smell be complete or partial.' Anosmia from other causes than injury is described elsewhere. *See* Olfactory Nerve, Disorders of; and Smell, Disorders of.

Treatment.—The treatment of anosmia is somewhat unsatisfactory. In cases where it depends on obvious causes, the removal of these may entirely or partially restore the sense of smell; and in other cases the excitation of the Schneiderian membrane of the nasal cavity, by the continuous galvanic current, promises better results than the administration of medicine or local applications.

2. **Blood Clots.**—As a result of injury, or of very violent blowing of the nose, extravasations of blood may take place, and form masses in the nostrils, which often set up inflammation, terminating in ozæna. In a case lately under the writer's care, a large, hardened blood-clot—which had been originally diagnosed as a morbid growth, and given rise to great inconvenience—was detached from the posterior nares, by the repeated use of the nasal douche.

3. **Foreign Bodies in the Nasal Passages.**—Peas, cherry-stones, and the like are often inserted into the nostrils by children, and if found out at once can be, generally speaking, readily removed. When a foreign body has remained for any length of time in the nasal fossæ, it becomes coated with calcareous matter, and forms a calculus, setting up a most offensive discharge, ulceration of the mucous membrane, and necrosis of the cartilages or bones. In all cases of persistent discharge from the nostrils the impaction of a foreign body should be suspected, and examination made by gentle probing or the rhinoscope.

Treatment.—In attempting to remove a foreign body from the nasal passages, it is as well to avoid the use of forceps, as the blades in attempting to catch the body, are liable to cause its impaction. A small slender hook may be passed behind the body, or a very fine screw into it, and so it can be withdrawn, as suggested by Gross. The removal of masses that have long been retained in the nasal passages may sometimes be effected by the nasal douche, using a strong stream directed into the sound nostril; or by means of curved bougies passed from behind. Pushing the impaction backwards into the pharynx is always rather hazardous, as it may pass into the larynx. Occasionally foreign bodies have been so long in the nose, and become so firmly impacted, that external incision has to be made, and the structures forming the external nose freely divided in order to reach them; or the method of Rouge, of operating through the mouth, may be employed.

Insects, leeches, or intestinal worms may get into the nasal passages, and from them pass into the sinuses. It has been proposed to destroy these by vapour of alcohol or turpentine.

**4. Inflammation of the Septum Narium.**—Acute inflammation of the septum narium is generally a result of injury, and may terminate in abscess, the diagnosis of which from polypus is easy. The abscess should be promptly opened.

In chronic inflammation of the nasal septum, which is very frequently the result of syphilis or scrofula, there is often necrosis of the cartilaginous septum, resulting in perforation, which may give rise to great deformity, on account of the depression of the nose following it. As regards treatment, in some instances, perhaps, the persistent dilatation of the nostril may be useful; and should there be a disposition of the ulcerative process to spread, the edges should be touched with either a strong solution or the solid stick of nitrate of silver. The constitutional treatment must, of course, be dependent on the cause of the ulceration.

**5. Rhinolithes, or Nasal Calculi.**—These masses are generally the result of the impaction of some foreign body, around which the inspissated mucous and purulent secretion of the nasal passages has formed, retaining it as a sort of nucleus. Or they may occur spontaneously; and, according to Demarquay, consist of phosphates of lime and magnesia, and carbonate of lime, magnesia, and soda.

Rhinolithes cause symptoms of obstruction and irritation, and sometimes set up severe inflammation and discharge. Before attempting their extraction, the posterior nasal douche should be employed to wash away the accumulated secretion, and to assist in dislodging the mass, which may be subsequently crushed, and removed piecemeal or entirely.

**6. Submucous Infiltration of the Sides of the Vomer.**—This affection has been called attention to by Cohen, and 'consists of a puffy condition of the mucous membrane over the vomer, which, by giving rise to symptoms of obstruction at the posterior part of the nares, has been mistaken for polypus. On examination with the rhinoscope, there is observed on each side of the septum, and confined to its posterior portion, a tumid mass of whitish colour, markedly distinct from the red colour of the adjacent mucous membrane. The affection is usually symmetrical, but often exists to a greater extent upon one side than the other. The masses are roundish, with very convex outlines, and sometimes extend half-way across the fossæ, and occasionally very close to the outer margin of the nares, if not in contact with them. The disease appears to consist in an œdematous protrusion of the mucous membrane, from an accumulation beneath it of serum or serous mucus.'

Treatment.—The treatment consists 'of tearing away portions of the protrusions, by forceps carried up behind the palate or through the nostril, and subsequent cauterisation of the parts. The affection is an obstinate one, and may recur again and again.' In the œdematous membrane, removed in one such case, there was abundant evidence of mycelium (Cohen, *Diseases of the Throat.*)

**7. Tumours.**—*a. Cartilaginous growths* have been met with in connection with the septum.

*b. Polypi* of the nasal passages are fully described elsewhere. *See* Polypi.

*c. Neuromata* have been met with in the nostril, and mistaken for polypus.

*d. Adenoma* of the pituitary glands has been recorded (*Archives générales*, Oct. 1876), occupying the superior and anterior portion of the nasal fossæ. The growth was removed by external incision.

*e. Adenoid vegetations in the naso-pharyngeal cavity* have been described by Meyer, of Copenhagen (*Trans. Med. Chir. Soc.*, vol. liii). They may spring from any part of the naso-pharyngeal cavity, except the septum; and the most prominent structural character of the growth is adenoid. They vary in shape according to the wall from which they spring, being sometimes cristate, cylindrical, or flat; and they are in general highly vascular.

Symptoms.—The symptoms of such vegetations depend, of course, on their number, size, and locality; but one is led to their detection by observing that the patient is compelled to keep the mouth open, on account of the closure or partial closure of the air-passages through the nose; by the attenuation of the external nose; and by the voice losing its resonance in the naso-pharyngeal cavity, which causes a peculiar 'deadness' of the pronunciation. There may be, moreover, a sensation of the existence of a foreign body, from the involvement of the Eustachian orifice. Meyer lays down the general rule that 'a deaf patient who breathes through the mouth, and has a thin compressed nose, is affected with vegetations in the naso-pharyngeal cavity.' The detection of these growths is often best accomplished by the finger passed up behind the velum, when they may be felt as soft masses yielding to the finger, and giving the sensation of a bunch of earth-worms. Rhinoscopic examination is very difficult and, as a rule, unsatisfactory in these cases. The writer has recently met with a case of this nature, which was readily diagnosed by the finger.

Treatment.—The treatment consists in cauterisation, if the growths are soft and small, and the use, by means of the nasal douche, of a watery solution of common salt, or bicarbonate of soda (1 in 500), which washes away the mucus, and also alters the condition of the secretory surfaces. When larger vegetations exist, operative methods, such as crushing or scraping off the masses as near their bases as possible, must be resorted to through the nose, or the employment of the galvano-cautery.

*f. Cancer* in all its forms may involve the nasal fossæ, originating most often in the antrum; epithelioma usually commencing on the outside, or edge of the alæ. The only treatment is obviously prompt removal on detection, and even then the prognosis is most unfavourable.

*g. Osseous tumours* occur frequently in the internal nose. Dr. Olivier (*Sur les Tumeurs osseuses de Fosses Nasales et des Sinus de la Face*: Paris, 1869) calls attention to growths of this nature, which are developed either in the nasal fossæ, or in the tissues connected therewith, and states that they are characterised by the following conditions. 1. That they contain in their anatomical constitution only the elements of osseous tissue, spongy or compact. 2. That they are primarily developed in the fibro-mucous

membrane which lines the cavities of the nasal fossæ and the sinuses. So far as they involve the nasal cavities, the following facts present themselves. The tumour is generally to be seen at the anterior portion of the nostrils. If the bony tissue be still covered by the mucous membrane, that membrane retains its usual characters; but if the growth be carious, it becomes of a greyish hue; and in the event of ulceration, the growth can be readily distinguished. These osseous tumours of the nose invariably cause some exophthalmos, whilst respiration and phonation are interfered with.

Treatment.—The treatment of osseous tumours of the internal nose consists in their removal by methods which must be obviously conducted according to their position, size, or nature. Sometimes they are so enormously hard that no instrument will touch them, and sometimes so soft and friable that the greatest care is necessary to remove them in their entirety; and indeed it has been suggested by Ollivier, in the instance of these friable growths, to attempt to remove them in fragments before making external incisions, which will expose the growth entirely. In a case of the ivory variety lately under the writer's notice, the tumour sprang from the frontal sinus and extended along the infundibulum, presenting in the nose as a large round nodule about the size of a marble, covered with mucous membrane, and of stony hardness; there was little if any displacement of the external parts. With regard to the operative proceedings for the removal of such growths, or indeed for gaining a thorough view of the nasal passages, the method devised by Rouge, of Lausanne, is by far the most effective. It consists in dividing the mucous membrane of the upper lip, at its junction with the jaw, freely, into the base of the anterior nares; in cutting subsequently through the nasal cartilages; and in turning the lip and external nose upwards, so that a complete view of the nasal cavities is thus obtained over the roof of the palate.

Other diseases affecting the internal nose are discussed in separate articles. *See* Coryza; Epistaxis; Influenza; and Ozæna.

Edward Bellamy.

**NOSOPHYTA** (*νόσος*, a disease, and *φυτὸν*, a plant).—A term employed by Gruby to designate a group of cutaneous affections, in which a fungus-formation constitutes an essential part of the disease. Naturalists have identified this fungoid growth with vegetable fungi in general, and have noted several species. Pursuing the same idea, they have regarded this fungoid matter as real fungi, vegetating in the skin, drawing their sustenance from the juices of that tissue, producing sporules, and diffusing those sporules, after the manner of seeds, as the means of propagating the species, and consequently, the disease.

In this view of the nature of the fungoid development, those diseases in which the fungi are found are termed 'parasitic,' and the contagious nature of such affections is thence inferred. One additional factor becomes necessary, namely, that the skin should be in a condition favourable for the reception and development of the parasitic plant. The precise pathological state constituting the disease may be denominated 'phytosis,' whilst the seat of its manifestation is the epidermis, the rete mucosum, the epithelium of the follicles, the nails, and the hair.

One of the most important of the cutaneous nosophyta is tinea, or ringworm; hence the word tinea is employed synonymously with phytosis; and we are enabled to enumerate as examples of the disease:—Phytosis *seu* Tinea tonsurans, circinata, favosa, and versicolor; whilst we also note that phytosis is present in certain forms of folliculitis, for example, in lichen marginatus and in sycosis. Phytosis, moreover, is a concomitant of onychogryphosis. *See* Phytosis; Ringworm; and Tinea.

Erasmus Wilson.

**NOSTALGIA** (*νόστος*, return, and *ἄλγος*, sadness).—Synon.: Fr. *Nostalgie*; Ger. *Heimweh*.—A form of melancholia, sometimes occurring in persons who have left their homes. The symptom from which it derives its name is an intense desire to return home; and this is accompanied by great mental and physical depression, which may end fatally. *See* Melancholia.

**NUMMULATED SPUTUM** (*numma*, a coin).—A form of sputum which, when spreading out on a surface, resembles a coin in shape. *See* Expectoration.

**NURSES, Training of.**—Training is to teach not only what is to be done, but how to do it. The physician or surgeon orders what is to be done. Training has to teach the nurse how to do it to his order; and to teach, not only how to do it, but *why* such and such a thing is done, and not such and such another; as also to teach symptoms, and what symptoms indicate what of disease or change, and the 'reason why' of such symptoms.

Nearly all physicians' orders are conditional. Telling the nurse what to do is not enough and cannot be enough to perfect her—whatever her surroundings. The trained power of attending to one's own impressions made by one's own senses, so that these should *tell* the nurse how the patient is, is the *sine quâ non* of being a nurse at all. The nurse's eye and ear must be trained—smell and touch are her two right hands—and her taste is sometimes as necessary to the nurse as her head. Observation may always be improved by training—will indeed seldom be found without training; for otherwise the nurse does not know what to look for. Merely looking at the sick is not observing. To look is not always to see. It needs a high degree of training to look, so that looking shall tell the nurse aright, so that she may tell the medical officer aright what has happened in his absence—a higher degree in medical than in surgical cases, because the wound may tell its own tale in some respects; but highest of all, of course, in children's cases, because the child cannot tell its own tale; it cannot always answer questions. A conscientious nurse is not necessarily an observing nurse; and life or death may lie with the good observer. Without a trained power of observation, no nurse can be of any use

in reporting to the medical attendant. The best one can hope for is that he will be clever enough not to mind her, as is so often the case. Without a trained power of observation, neither can the nurse obey intelligently his directions. It is most important to observe the symptoms of illness; it is, if possible, more important still to observe the symptoms of nursing; of what is the fault not of the illness but of the nursing. Observation tells *how* the patient is; reflection tells, *what* is to be done; training tells *how* it is to be done. Training and experience are, of course, necessary to teach us, too, *how* to observe, *what* to observe, *how* to think, *what* to think. Observation tells us the fact; reflection the meaning of the fact. Reflection needs training, as much as observation. Otherwise the untrained nurse, like other people called quacks, easily falls into the confusion of '*on account of*,' because '*after*'—the blunder of the 'three crows.' The nurse is told by the medical attendant, 'If such or such a change occur, or if such or such symptoms appear, you are to do so and so, or to vary my treatment in such or such a manner.' In no case is the physician or surgeon always there. The woman must have trained powers of observation and reflection, or she cannot obey. The patient's life is lost by her blunder, or 'sequelæ' of incurable infirmity make after-life a long disease; and people say, 'The doctor is to blame;' or, worse still, they talk of it as if God were to blame—as if it were God's will. God's will is *not* that we should leave our nurses, in whose hands we must leave issues of life or death, without training to fulfil the responsibilities of such momentous issues.

To obey *is* to understand orders, and to understand orders really is to obey. A nurse does not know how to do what she is told without such 'training' as enables her to understand what she is told; or without such moral and disciplinary 'training' as enables her to give her whole self to obey. A woman cannot be a good and intelligent nurse without being a good and intelligent woman. Therefore, what 'training' signifies in the wide sense, what makes a *good training-school*, what moral and disciplinary 'training' means, and how it is to be attained, are to be clearly understood.

I. *What makes a good Training-school for Nurses?*

(1) A year's practical and technical *training* in hospital wards, under *trained* head-nurses (so-called 'sisters' of London hospitals), who themselves have been *trained* to *train*.

For a district nurse, an additional three months' training in nursing by the poor bedside, under a trained and training district superintendent, is essential.

The training of probationers should be as much a part of the duty of the head nurse ('sister,') as directing the under-nurses or seeing to the patients.

To tell the training, you require weekly records, under printed heads corresponding with the 'List of Duties,' kept by the head-nurses of the progress of each probationer (pupil) in her ward-work, and in the moral qualities necessary in her ward-work; a monthly record by the matron of the results of the weekly records; and a quarterly statement by her as to how each head-nurse has performed her duty to each probationer. The whole to be examined periodically by the governing body.

(2) Clinical lectures from the hospital professors; lectures on subjects connected with nurses' special duties, such as elementary instruction in chemistry, with reference to air, water, food, &c.; physiology, with reference to a knowledge of the leading functions of the body; and general instruction on medical and surgical topics; examinations, written and oral, at least four of each in the year, all adapted to nurses; as also lectures and demonstrations with anatomical, chemical, and other illustrations, adapted especially to nurses—all in the presence and under the care of the matron (Lady Superintendent) and mistress of probationers (Class-mistress and 'Home'-sister); together with instruction from a medical instructor, one of the hospital professors and hospital medical staff, specially selected to teach the nurses.

A good nurses' library of professional books, not for the probationers to skip and dip in at random, but to be made careful use of, under the medical instructor and class-mistress.

(3) Classes for a competent mistress to drill the professorial teaching into the probationers' minds; the mistress of probationers to be above all a 'home'-sister, capable of making the 'home' a real *home*, and of training and disciplining the probationers there in all good—in moral qualities, customs and habits, and manners, without which no woman can be a nurse, and in their duty and feeling to God as well as to their neighbour.

(4) The authority and discipline over all the women of a trained lady-superintendent, who is also matron of the hospital, and who is herself the best nurse in the hospital, the example and leader of her nurses in all that she wishes her nurses to be, in all that training is to make her nurses.

(5) An organisation not only to give this training systematically, and to test it by current tests and examinations, but also to give the probationers, by proper help in the wards, time to do their work as pupils as well as assistant-nurses, and above all to make it a real moral as well as nursing probation—for nursing is a probation as well as a mission.

(6) Accommodation for sleeping, classes, and meals; arrangements for time and teaching and work; surroundings of a moral and religious, and hard-working and sober, yet cheerful tone and atmosphere, such as to make the training-school and hospital a 'home' which no good young woman of any class need fear by entering to lose anything of health of body or mind; with moral and spiritual helps, and an elevating and motherly influence over all, such as to make the whole a place which will train really good women, who can withstand temptation and do real work, and neither be 'romantic' nor 'menial.' For, make a hospital as good as you will, hospital-nurses require more such helps, and get less, than women either in their own homes or in domestic service.

Every hospital should have and *be* such a school for training nurses for itself and other

institutions, including district and private nurses, who must be trained in hospitals, and therefore cannot have a training-school of their own. Professors and medical staff cannot be always, or indeed ever at hospital bedsides, showing nurses what to do. Let each give the pupil-nurses a clinical lecture once a week. Above all, this is necessary for those who are to be head-nurses, matrons, and lady-superintendents. The success of any training-school depends mainly upon having trained nurses themselves capable of training others—(*a*) in ward-nursing; and (*b*) in cases, so as to be able to understand what physician and surgeon order, and do it.

II. *Course for all Probationers.*

(1) To do duty as assistant nurse and probationer successively in one or more wards of each of the hospital divisions, one or two or three months in each, male and female surgical, male and female medical, children's, obstetric, ophthalmic, Magdalen; ending her course, if possible, in the medical-instructor's wards.

The course should, if possible, *begin* in the female medical wards. No two *fresh* probationers to be in the same ward. One nurse-probationer and one lady-probationer to be together, where possible.

(2) To learn ward-management by being in charge of wards during the head-nurse's dinner-hour, and during nurses' recreation hours; to take, when sufficiently advanced in the year's training, day or night staff duty for staff-nurses on their holidays; to have at least one month's night duty—a fortnight at a time—in the year's training.

(3) To take, when sufficiently advanced, special duty, by day or by night, upon special cases, such as ovariotomy, lithotomy, tracheotomy, typhoid, &c., in the single-bed wards.

(4) To make a set of all the different bandages required.

(5) To learn from the head-nurse to read the 'cards,' or patients' bed-tickets, especially in the medical wards.

(6) To keep a diary of her ward duties.

Besides this diary, each probationer at least once a month to draw up a sketch of her day's work, not merely as a ward assistant or assistant nurse, but as a probationer in training, namely, what she has learnt that day from ward-sister and staff nurse, what she has observed on special cases in the ward, &c.

Warning is given out only *after* the day's work, that it is such and such probationer's day to write it out.

(7) To take careful notes of cases. A case-paper should be regularly kept by every probationer of cases selected by the medical instructor.

The case-paper to have printed headings, such as 'Temperature,' 'Pulse,' 'Respiration,' to be taken morning and evening [in some cases the physician will require the 'temperature' to be taken as often as every hour, or even every quarter of an hour]; 'Sleep,' 'Nourishment,' 'Urine,' 'Stools,' to be noted every twenty-four hours—in each case character as well as quantity; 'treatment,' to be noted daily, in English, and not copied off the 'cards;' and other such heads; preceded by a real medical history of the case—of the causation of the disease; for example, in typhoid fever and other dirt diseases, produced by foul air and foul water. This is followed by remarks on the termination of the case. These case-papers should be rigorously overhauled by ward-sisters and the class-mistress, as well as by the medical instructor, who should also at his own hospital-beds check the case-taking.

(8) To take careful notes of all lectures, also overlooked by class-mistress and medical instructor.

(9) To read and be shown illustrations of the cases nursed in the wards, [the keen professional interest felt by a promising probationer in finding her own cases in a book must be encouraged.]

(10) To jot down afterwards, but while still fresh in the memory, any remarks suitable for her own instruction made to the students by the hospital physicians and surgeons in going their rounds, and to write out her jottings in the class-room under the superintendence of the 'home'-sister.

(11) To write out under the superintendence of the 'home'-sister what has been learnt both from ward-sisters and medical instructor as to what is to be done and how to do it in nursing; as to *why* it is done, and why something else is not done; as to symptoms and the 'reason why' of such symptoms.

Without (*a*) time for these things, average nurse-probationers degenerate into conceited ward-drudges. Without (*b*) a system for these things, they potter and cobble out their year about the patients, and make not much progress in real nursing, that is, in obeying the physicians' and surgeons' orders intelligently and perfectly.

III. *Training to Train.*—To enable nurses to train nurses, a special training is required; and for this a longer period than a year in the hospital is necessary. To *train* to *train* needs a system:—

(1) A systematic course of reading, laid down by the medical-instructor, who recommends the books for the training-school library. Hours of study, say two afternoons a week; class-mistress ('home'-sister) to lead one at least of these afternoons.

(2) Regular oral examinations by medical-instructor; each training-nurse must acquire powers of expression to train others. He must cultivate these in answering him. Some system of mutual examination.

(3) At least four written examinations in the year on written questions, by the medical instructor. Essays to be written on given subjects in nursing.

(4) Pre-eminently careful notes of lectures, in order to enable nurses in future to drill others in understanding the professorial lectures, as they have themselves been drilled.

(5) Pre-eminently careful notes of cases—the touchstone for the future trainer. If she cannot observe and understand her own cases, how can she teach others to observe and understand them? If she never learn the reason of what is done, how can she train others to learn it? 'Reading up' her own cases.

(6) A current constant course of careful learning from head-nurses and medical instructor and physicians or surgeons in wards where she

is probationer, to know not only what symptoms are there, and what symptoms are to be expected in such and such an event, but also the *meaning* of such symptoms—the 'reason why.' To know not only when a wound or surgical injury or operation 'looks well and when it 'looks ill,' but *why* it looks well or ill; and to be able to tell others *why*. To know not only what is to be done, and how it is to be done, but *why that* is done, and not something else.

(7) At least twice in the year's training, but not at the beginning, to have a week or more of going the night-rounds with the night-superintendent of nurses, which is equally good for night-superintendent and for probationer.

(8) To spend at least a week, but not at the beginning of her year, in the linenry.

(9) The future superintendent, who is to have a training school, should have *at least* a fortnight in the year, about six or nine months on in her training, in the 'Home,' if possible, taking or assisting at classes, and doing all but the 'Home' sister's secretarial work.

(10) Taking temporary duty of ward-sisters on their holidays, and—the best—of 'Home' sister on her holiday. Of course no fresh probationer, however gifted, would be put on such duty.

(11) Being relieved of the more menial ward-work, such as cleaning lavatory basins, w.c. pans, &c., when she can do it so perfectly of herself without being told, that she can teach others to do it. This will scarcely be, for all kinds of this ward-work, before she is a six months' old probationer.

(12) A second year's training for the higher posts. A future matron or lady-superintendent to have had experience as ward-sister, and to have had at least one year as assistant-superintendent and as night superintendent, in some hospital under a trained lady-superintendent.

(13) The matron must give future matrons or superintendents insight into her duties. There must be an examination and questions given on superintendents' work.

IV. *Current tests, current records of progress, and examinations.*

(*a*) The candidate should fill up a form of application, answering printed questions. Regulations of training printed on the back.

(*b*) Should enter on a month's trial. She receives the time-table and the list of duties.

If the candidate is accepted after the month as probationer—

(*c*) Each ward head-nurse or sister keeps a record of each probationer, under printed heads corresponding with the list of duties. She fills up the columns with suitable marks once a week. The matron, after examining the ward-sister's reports with ward-sister and 'home'-sister present, and questioning each ward-sister on each probationer, records her own opinion on the sister's reports. The medical instructor once a month should examine each probationer separately, upon the duties which the ward head-nurse (sister) has 'recorded' her as defective in, in the presence of ward-sister, 'home'-sister, and matron; and also should examine each ward-sister separately upon her records of each probationer in the matron's presence, but not in the probationer's.

The 'home'-sister also furnishes a record of each probationer's conduct at the classes and in the home.

(*d*) A register with two pages for each probationer should be kept monthly by the matron assisted by the 'home'-sister. It corresponds with the ward-sister's book, and has monthly entries for the whole year of training. The accounts in these books must tally at the end of the year, or somebody has been wanting in moral courage.

(*e*) While the ward-sisters keep a weekly and the matron a monthly record of the progress of each probationer, she is required to keep a diary of her ward work, to keep 'case-papers' with the daily changes in case and treatment, and to keep notes of lectures; and the careful examination of these affords important items in the records of results of training, and of the capabilities of each probationer. The medical instructor enters his verdict on professional points in the monthly register.

(*f*) The medical instructor, and each hospital professor who gives lectures to the probationers, examines them orally in the presence of matron and home-sister. He examines their notes of the lectures and awards marks. It is communicated to each probationer how she stands as to marks.

(*g*) Written questions are given by the medical instructor at least four times a year, to be answered in writing, at least by the probationers who are training to train others. Marks are awarded, and the number of marks received communicated to each probationer. Possibly prizes may be given for proficiency.

These are some of the current tests of the results or non-results of training, of progress or no progress. Without some regular system of this kind, there can be no real organization for training. The heads of the training school *must* 'take stock' and know where each probationer really stands, and what the training is really doing, and must let each probationer know where she stands. The matron must be one whose desire is that the probationers *shall* learn: a rarer thing than is usually supposed. But besides this there is a constant, motherly, intangible supervision and observation to be exercised, for there are qualities which no written tests can touch and no examinations can reach. The probationers must really be the matron's children; the 'home' sister must really be their elder sister.

A training school without a mother is worse than children without parents. And in disciplinary matters none but a woman can understand a woman.

V. *Staff of Training School:*—

1. The *superintendent* of the training school is the matron of the hospital, and head of all the women in the hospital. She is present when possible at the probationers' lectures and demonstrations, and oral examinations, with the 'home'-sister, who is always present. The night-superintendent of nurses trains the probationers told off to accompany her at night.

2. The trained '*home*'-*sister* (class-mistress; mistress of probationers) resides in the 'home'; is in charge of the 'home' and its servants and of the probationers. She gives two classes a week at least to the senior nurse-probationers and two

to the juniors, drilling them in the medical instructor's lectures, &c. &c. She superintends two afternoons at least in the week the study hours of the probationers training to train others, that is, all who are to be in future in charge of nurses, whether as ward-sisters, matrons or superintendents, and gives direct instruction on one at least of these afternoons. She gives singing and Bible classes. She must from time to time communicate with the ward-sisters on the defects in the probationers' work, and concerning probationers about whom she may feel uneasy. Cutting off communication between hospital and 'home'-sister is very objectionable; the hospital-sister must not want moral courage to let the probationers know any unfavourable report she has made of them in the Sisters' Records. This is unfair to the probationers. The 'home'-sister must attend all clinical and other lectures, demonstrations, and examinations.

3. *Ward-Sisters* (Head-nurses, Training-nurses).—The ward-sister must train the probationers in all the duties of a nurse. *See* NURSING THE SICK; and above, 'II. Course for Probationers.'

The ward-sister, or—instructed by her—the staff nurse, is to *show* every new probationer how to do her work; not only what things are to be done, but how she is to guard against the *way* they are not to be done, as well as against what is not to be done. She is to instruct the nurses how to instruct probationers. As it is impossible for a 'sister' with a sister's duty in a 'heavy' ward always to have time to show all needful things herself to the probationer; the sister must from time to time question her to see if she has been shown her duties and how she does them, remembering that it is of use to the probationers to put these things into words; and for this purpose each probationer is to be occasionally taken by the sister on her ward rounds, and examined as to what she has done in each case under her charge, whether she has learnt to do it rightly and knows 'the reason why.'

The ward-sister must also train the probationers in alacrity of intelligent obedience to *her* medical authorities, which must be the probationer's lesson of what obedience ought to be. She must regard the probationers less as hospital servants, than as pupils to be trained for hospital 'sisters' and nurses. The training-nurse must be a bridge for the pupil-nurses. 'He who will be a chief, let him be a bridge.' She must not make them too little of pupils, too much of assistant-nurses—or, rather, they cannot be too much of assistant-nurses, but being too little of pupils makes them too little of real assistants, and (for all their future) of real nurses. The training-nurse must interest the pupil-nurse in her cases. The pupil cannot have a nurse's interest in them without knowing *what they are*. Cases she is interested in she nurses with twice the efficiency.

4. *Medical Instructor.*—The medical instructor, one of the hospital staff who will undertake the duties, gives a lecture once a week on medical and surgical topics specially connected with nursing duties; demonstrations with anatomical and other illustrations, specially adapted to nurses; lessons on the elementary knowledge of physiology, anatomy, the situation of the principal arteries, &c.; lessons on bandaging; lessons in hygiene, both of wards and patients; lessons on the causation of disease; on what is to be done in emergencies; on how to make beds for various operations and diseases, &c., &c. He is to lay down a systematic course of reading for the probationers who are to train others; to examine them by written questions at least four times in the year; to give them subjects for essays, and to examine these; to award marks. He is to examine all the probationers orally; to examine their notes of lectures, to award marks; to examine their case-papers. He is to give clinical lectures at least once a week, at his own 'beds' (it would be desirable if each probationer could end her course of wards in the medical instructor's wards), and to examine 'case-papers' taken of his own cases; to teach symptoms, and what symptoms indicate, and *why* such or such a treatment; and what shows a case to be 'doing well' and what 'ill'; and to teach the probationers so that they can teach other probationers in their turn. He will encourage in every way the professional interest of the nurse in the cases she is nursing; he will point out these cases in medical and surgical books. Once a month he will examine each probationer separately upon the duties she is defective in; and each ward-sister separately upon her recorded experience of each probationer. He will fill up the monthly register at the end of each probationer's year of training, with his verdict on her capacities, and on such professional results of her training. He will make up the purely professional columns—such as 'observation,' 'operations'—every month, seeing the matron and ward-sisters for the purpose. The medical instructor should be one of mature age and experience; should be really a father to the pupil-nurses, and one whom the matron can freely consult with. If the hospital have a *permanent* resident medical officer fit for the purpose, he should be the instructor.

5. The medical instructor also gives elementary instruction in chemistry, physiology, anatomy, surgery, medicine, as far as they bear upon nurses' duties.

6. *Lady Visitor.*—The lady visitor should not be resident in the hospital, but should herself have been a trained nurse, so as to know what training is. She will be an essential assistance to the matron, in infusing spirit from without into her training school, and in saving the matron from the appearance even of arbitrary power.

**Training, general consideration of.**—A year's training is simply teaching the nurse her A B C—teaching her how to go on learning for herself, learning to understand her doctor's orders and to read her own experience, for mere experience may only teach the '*post hoc, ergo propter hoc.*' A nurse without training is like a man who has never learnt his alphabet, who has learnt experience only from his own blunders. Blunders in executing physician's or surgeon's orders upon the living body are hazardous things, and may kill the patient. Training is to enable the nurse to see what she sees—facts, and to do what she is told; to obey orders, not only by rule of thumb, but by giving her a rule of

thought or observation. Otherwise she finds out her own mistakes by experience acquired out of death, rather than life, or does not find them out at all.

Medicine, surgery, pathology, and, above all, hygiene, have made immense strides, partly in consequence of improved tools, improved instruments of observation. Nursing, their agent, has to be trained up to them. A good nurse of twenty years ago had not to do the twentieth part of what she is required by her physician or surgeon to do now. And every five or ten years a nurse really requires a second training now-a-days. Nursing needs its instruments nearly as much as surgery, and yet more than medicine. The physician prescribes for supplying the vital force—but the nurse supplies it. Training is to teach the nurse how God makes health and how He makes disease. Training is to teach a nurse to know her business, that is, to observe exactly, to understand, to know exactly, to do, to tell exactly, in such stupendous issues as life and death, health and disease. Training is to enable the nurse to act for the best in carrying out her orders, not as a machine but as a nurse; not like Cornelius Agrippa's broomstick which went on carrying water, but like an intelligent and responsible being. Training has to make her, not servile, but loyal to medical orders and authorities. True loyalty to orders cannot be without the independent sense or energy of responsibility, which alone secures real trustworthiness. Training makes the difference in a nurse that is made in a student by making him prepare specimens for himself instead of merely looking at prepared specimens. Training is to teach the nurse how to handle the agencies within our control which restore health and life, in strict obedience to the physician's or surgeon's power and knowledge—how to keep the health-mechanism prescribed to her in gear. Training must show her how the effects on life of nursing may be calculated with nice precision—such care or carelessness, such a sick-rate, such a duration of case, such a death-rate.

FLORENCE NIGHTINGALE.

**NURSING THE SICK.**—Nursing proper, that is, nursing the sick and injured, will be here treated of, and not Preventive or Sanitary Nursing, or nursing healthy children.

Nursing is performed usually by women, under scientific heads—physicians and surgeons. Nursing is putting us in the best possible conditions for Nature to restore or to preserve health—to prevent or to cure disease or injury. The physician or surgeon prescribes these conditions—the nurse carries them out. Health is not only to be well, but to be able to use well every power we have to use. Sickness or disease is Nature's way of getting rid of the effects of conditions which have interfered with health. It is Nature's attempt to cure—we have to help her. Partly, perhaps mainly, upon nursing must depend whether Nature succeeds or fails in her attempt to cure by sickness. Nursing is therefore to help the patient to live. *Training* is to teach the nurse to help the patient to live. Nursing is an art, and an art requiring an organized practical and scientific training. For nursing is the skilled servant of medicine, surgery, and hygiene.

Nursing may be divided under four heads:—(*a*) *Hospital* nursing. (*b*) *Private* nursing: that is, nursing one sick or injured person at a time, at home; giving the whole time to that one patient, generally of the richer classes. (*c*) *District* nursing: that is, nursing the sick or injured poor at home, taking as many cases as can be well attended to by one nurse. District nursing, or nursing the sick poor at home, is a branch of nursing of the highest importance, and requires the highest qualifications, because the district nurse has not, like the hospital nurse, a medical and surgical staff always at her call, and never hospital appliances to her hand. (*d*) *Midwifery* nursing will not be treated of here. It differs from other nursing in this—that the lying-in woman, the patient, is not, or ought not to be, sick, and that the nursing consists in a surgical operation and in hygienic precautions. [Midwifery and general cases should never be attended by the same nurse. No ordinary precautions will secure the lying-in case from danger arising out of this practice.]

(*a*) *Hospital Nursing.*—Nursing proper means, besides giving the medicines, and stimulants prescribed, or applying the surgical dressings and other remedies ordered:—1. The providing, and the proper use of, fresh air, especially at night, that is ventilation, and of warmth or coolness. 2. The securing the health of the sick-room or ward, which includes light, cleanliness of floors and walls, of bed, bedding, and utensils. 3. Personal cleanliness of patient and of nurse. quiet, variety, and cheerfulness. 4. The administering and sometimes preparation of diet (food and drink). 5. The application of remedies. In other words, all that is wanted to enable Nature to set up her restorative processes, to expel the intruder disturbing her rules of health and life. For it is Nature that cures: not the physician or nurse. We shall now discuss these duties in succession.

**1. Ventilation. Warmth and Coolness.**—*a. Ventilation* is the removal of the air poisoned by the breath and other human emanations, and supplying its place with *fresh* air.

The very first canon of nursing is to keep the air inside as fresh as the air outside, by night as well as by day, without chilling the patient. The best rule of ventilation is still: Poke the fire, open the window, but *at the top*, for fresh air coming in at the ceiling permeates the whole room, without causing draught, and foul air escapes. Air coming in at the floor or at the level of the patient remains there and chills him, and foul air does not escape. Always air from the outside air. Windows are made to open, doors are made to shut. If the nurse ventilate the patient's room or ward through the door—that is, making the room draw the foul air from the rest of the house or building—she ventilates him with foul not fresh air. But ventilation is impossible without sufficient floor and cubic space. and unless the windows open near the ceiling. Where other patients want air, fever patients, for example, want wind; where other sick want a well-aired room, without draughts, pyæmic patients, for example, want the freest possible supply of air about their beds.

*b. Warmth or coolness.*—This the physician

has to prescribe—the nurse has to see to it. In fever, for instance, the physician will require her to examine the patient's feet and legs, at least every hour, to ascertain whether they are chilled, and to keep the extremities warm, even though his temperature be high, whether in summer or winter.

In bronchitis, in ovariotomy, &c., an even, high, moist temperature may be necessary, and a steaming kettle may be required on the fire night and day.

But ordinarily it is not advisable to keep the sick-room always at the same temperature. A cooler air at night is necessary. But whether cool or warm, the air must be *fresh*. Sick children become fretful in foul air at night. And young as well as old night-nurses require training to see that the physician's orders are obeyed as to keeping the air of the ward fresh by night, and not above or below a certain temperature.

The head of the sick should never be higher than the throat of the chimney, which ensures the best air. And the chimney should never be closed with a chimney-board.

**2. Health of Sick-Room, or Ward.**—This might be called 'nursing the room.' The placing the sick-bed in the best position to secure air without draught, light without glare, quiet and cleanliness—and this often necessitates rearrangement of the furniture of the whole room—is one of the essential arts of nursing. In district nursing of the poor, it must be one of the nurse's first duties to put the room in a state so that the patient *can* recover. So, too, must the hospital and the hospital-ward be built so that the patient shall not 'die of hospital.' To get rid of the conditions which have interfered with health is of course the first nursing step in helping Nature to get rid of the effects of those conditions.

*a. Light.*—Second only to air is light as an essential for growth, health, and recovery from sickness—not only daylight but sunlight—and indeed *fresh* air *must* be sun-warmed, sun-penetrated air. This should be meant to include colour, pleasant and pretty sights for the patient's eyes to rest on—variety of objects, flowers, pictures. People say the effect is on the mind. So it is; but the enlightened physician tells us it is on the body too. The sun is a sculptor as well as a painter. The Greeks were right as to their Apollo.

*b. Cleanliness.*—Cleanliness and fresh air do not so much give life as they are life itself to the patient. Cleanliness—clean air, clean water, clean surroundings, and a fresh atmosphere everywhere are the true safeguards against 'infection'—not segregation—or rather segregation by ample floor and cubic space, ample ramparts of fresh atmosphere: not segregation by walls and divisions. You cannot lock-in or lock-out the infectious poison; you cannot wall-out infection. You *can* air it out, diffuse it, and clean it away.

'Infectious Hospitals' and 'Wards,' whether necessary or not, are not a part of hygiene; and the doctrine of 'disease germs,' in the sense in which it may lead to considering 'infection' inevitable, must not be taught as a principle of sanitary nursing. That there is no such thing as 'inevitable' infection, is the first axiom of nursing.

Cleanliness of floors, ceilings, walls, bed, bedding, and utensils, and of sinks; also of lockers, if any, but there should be none.

*Floors and walls.*—Medical men forbid scrubbing in the sick-room. No sick-room floor ought ever to be washed, except by the doctor's orders and at the hour he orders.

The only clean floor is a floor planed, saturated with 'drying' linseed oil, well rubbed-in, stained (for appearance' sake), not too dark, so as *not* to hide the dirt, and beeswaxed with turpentine and polished. The floor to be wiped with a damp cloth and dried with a floor-brush, or cleaned by a brush with a cloth tied over it. Anything offensive spilt to be washed off at once with soap and water. Hospital-ward floors should be scraped and polished every fortnight by a *frotteur* and dry-rubbed by a man every day. The patients should be provided with slippers. No carpet, of course, in a sick-room, except a piece of washing drugget by the bedside. A dirty carpet literally infects the room.

The only clean wall is one that is oil-painted. From this you can wash the animal matters. These are what make a room musty. The worst wall is the papered wall. The next worst is the plastered wall. But the plaster can be made safe by frequent lime-washing and occasional scraping. The paper requires frequent renewing. A glazed paper gets rid of a good deal of the danger. But the ordinary bed-room paper is all that it ought not to be.

*Furniture*—as little as possible in the sick room—should all be of polished wood, metal, or marble, kept clean by being wiped with a cloth wrung out of hot water.

Air can be soiled just like water. Air is always soiled where walls and carpets are saturated with animal exhalations. Dust consists greatly of organic matter. There should be no ledges out of reach capable of holding dust. An Arnott's ventilator in the chimney will keep an ordinary paper longer clean, showing the connection of ventilation and cleanliness. Inattention to these essential matters all but foils the best nurse's best efforts.

*How to clean.*—Dust is the harbourer and harbinger of disease. Dust in hospitals may contain epithelial scales from the mouth, skin-epiderm, pus-cells. As there appears no limit to the reproduction of epiderm or epithelium, so there is no limit but excessive cleanliness to its deposit in dust in a hospital ward, 'which,' as a great surgeon has said, 'never rests from fouling itself.'

The only way to *remove* dust is to wipe everything with a damp cloth. And all furniture ought to be so made that it may be wiped with a damp cloth without injury to itself, and so polished or glazed that it may be damped without injury to us. Flapping, by way of dusting, is not cleaning. To 'dust,' as now practised, merely means to distribute dust more equally over a room. To 'tidy' a room, or 'put the room to rights,' means to remove a thing from one place which it has kept clean for itself on to another and a dirtier one.

No one atom of dust ever actually leaves the room under the present system of 'dusting.' The greater part of nursing consists in keeping clean. No ventilation can freshen a sick room where the most scrupulous cleanliness is not kept.

*Bed and bedding; linen, &c.*— Feverishness is generally supposed to be a symptom of fever; in nine cases out of ten it is a symptom of bedding. The patient has had re-introduced into his system the diseased emanations from himself, to eliminate which from his system Nature had appointed the disease. These, day after day and week after week, soak into his unaired bedding from below as well as from within, if the chamber-utensils are left, as is too often the case, unemptied and without a lid under the bed. Erysipelas and pyæmia are produced by an uncleansed state of bed and bedding. Black flock is sometimes used for fracture pillows. This gets full of dust, and may be the cause of erysipelas.

The most dangerous effluvia we know are from the excreta of the sick; these are placed, at least for a time, where they must throw their effluvia into the underside of the bed, and the space under the bed is never aired; it cannot be with our arrangements—a valance or counterpane down to the floor, or perhaps the quilt so carefully pinned over that no air can pass under the mattress.

An adult in health exhales by the lungs and skin in the twenty-four hours three pints at least of moisture, loaded with matter ready to putrefy; in sickness the quantity is often greatly increased, the quality is always more noxious. This goes chiefly into the bedding because it cannot go anywhere else: and it stays there, because, except perhaps by a weekly or bi-weekly change of sheets, scarcely any other airing is attempted. A nurse will be careful to fidgettiness about airing the clean sheets from clean damp, the clean night-gown from clean damp, the new mattress from clean damp; but airing the dirty sheets from dirty damp, the dirty night-gown (which she is going to put on the patient after washing him) from dirty damp, never so much as occurs to her. And a mattress is supposed to be aired by somebody else sleeping on it and saturating it with his own damp before the patient comes to exhale into it the patient's damp.

The bed is *always* saturated with the patient, and the unfortunate patient who lies in it is always being saturated with the bed.

The ordinary sick-bed of a private patient is generally exactly what it ought to be to bring this poisoning process to perfection: a wooden four-poster with curtains, two or even three mattresses, or even a feather-bed, piled up—perhaps to a height above the throat of the chimney or above the lower chink of the sash-window, which is all that is ever opened; the window not opening or opened at the top; a valance fastened to the frame. Nothing ever thoroughly dries or airs such a bed and bedding.

The best bed and bedding are: An iron bedstead with Rheocline springs, or the woven-wire mattress, no valance and no curtains, of course; one thin hair mattress, light Witney blankets, no heavy cotton counterpane, which retains perspiration; no blanket *under* the patient, which acts like a poultice and promotes bed-sores—bed-sores which are, all but always, a symptom not of the disease but of the nursing.

The patient should, if possible, be able to see out of window from the bed.

Two beds, one for the day and one for the night, are necessary for the best nursing of the patient. A true nurse always knows how to make a bed, and always makes it herself. And bed-making has much to do with bed-sores. She hangs up the whole of the bedding to air for a few hours whenever possible. She makes the changes of linen and bed-linen—sheets and draw-sheets—as often as is necessary, which is a great deal oftener than is usually done. In hospitals, she sees to no patient using his neighbour's towel; and to different towels being used for different purposes. She sees to all dirty linen, and especially bandages, being instantly removed, and, after a previous careful disinfection by steeping in boiling-water with a proportion of carbolic acid, 1 to 100, *being washed at a laundry separate from any other building*—if she has such a laundry. No disinfection will enable dirty linen to be kept with safety a single day in the same building with the sick. It is cruel to allow dirty linen from 'infectious' patients to be taken home by the relatives to be washed in the crowded rooms of the poor. Dirty linen should be removed immediately from the sick-room and sent to the laundry, at least every day. If we are careful to take away and empty bed-pans directly, surely this is still more important with soiled sheets. It must not be supposed that even a good sprinkling of carbolic powder (which besides injures the sheets) over the dirty linen lying in a basket, will at all obviate the necessity of instant removal. Foul-linen shoots, with a receptacle at the bottom to receive the linen in preparation for instant removal, are a necessity of every hospital.

*Bandages* with pus on them are always to be burnt at once—to be carried straight to the ward fire, or to a furnace. The best economy is to burn them; but one must make up the fire so that the burning shall not smell. Bandages used for fractures, &c., are the only bandages that may be washed. Soak these with chlorinated soda, a diluted pint; then boil them all night with soft-soap, soda, and chlorinated soda—a quart bottle for the two. The bandages are then to be rinsed in a tub. The boiler must, of course, only be emptied in a closet-sink. But this washing of bandages ought never to be done inside a dwelling-house or hospital.

All disinfectants are more or less a 'mystic rite,' as a great surgeon said. Absolute cleanliness is the true disinfectant; but chlorinated soda, if disinfectants are to be used, is about the best. Always have chlorinated soda for nurses to wash their hands, especially after dressing or handling a suspicious case. 'It may destroy germs at the expense of the cuticle;' but, 'if it takes off the cuticle, it must be bad for the germs,' said the same surgeon. Fire is the right way, if a thing is so bad that it wants a disinfectant. Hair (and all hospital beds should be of *hair*) should be heated to about 350°, teased, and exposed to air. Boil, wash, scour with much soap and water and, say, chloride of

lime; then dry and expose to air all bed-ticks, blankets, coverlids, &c.

*Utensils.*—All chamber-utensils and bed-pans should be of white glazed earthenware, with well-fitting lids. None should ever be left under the bed, but be brought to the room, and, when used, carried immediately to the closet-sink, emptied, and rinsed there. No zinc pail, or pail without a lid, should be carried through a ward or sick-room. The pail should be of glazed earthenware with a lid. But better no pail at all in a sick-room. Without care for these things, the doctor will tell us, 'it is impossible to nurse.' Excreta have often to be put by for medical inspection; the nurse must see to this being done properly and inoffensively, in a closed vessel—never in the patient's room or ward. As for urine, if it has to be measured and tested, there are glass-measures, with covers, fit for the purpose. Bed-pans should have carbolic-powder in them lavishly. All bed-pans should have lids. Glass urinals, with wide necks, washed with warm water and soda, are the only really clean ones; zinc and white earthenware, with long necks, are never clean. After being used, they should be put by the bedside, not under, and taken away and emptied at once. Small white chamber-utensils are useful, and district nurses may find old jam-pots the cleanest thing for urinals. Chamber-utensils in a hospital should be ranged on their sides in a sort of hutch open to the outward air through perforated zinc, in the lavatory or other compartment. If in a large hospital-ward chamber-utensils *must* unhappily be allowed under the beds at night, they should all, of course, have lids. Two glazed earthenware (not zinc) pails, with lids, may then be carried round the last thing at night and the first thing in the morning: one pail to empty into, with some carbolic-powder in it; one pail to rinse with, with soda or chlorinated soda in it. The chamber-utensils should be then carried off to the hutch in the lavatory. But this is only a *pis aller*; a slop-pail should really never be brought into a sick-room or ward at all. It should be a rule, invariable—rather more important in the private house than elsewhere—that the utensil should be carried directly to the water-closet, emptied there, rinsed there, and not brought back till it is wanted.

There should always be water and a tap in every water-closet for rinsing.

*Towels* in a hospital should be kept separate for three separate uses, changed for clean ones as often as possible, and marked 'Hands,' 'Bed-pans,' and 'Basins.'

A bottle of chlorinated soda and a bottle of glycerine should always be by, to wash the hands.

A young nurse, dressing an ulcerated leg, has been known to wipe it with the sheet, and alleged that she had seen it done elsewhere! There should always be a special towel for such cases. *Charcoal* may be employed in offensive cases; it may be placed under the bed in pans, or under the limb (if slung) in the bed. Carbolic powder may be placed in the chamber-utensil (clean), if under the bed, or little bags of carbolic powder in the bed. Condy's fluid is sometimes placed in saucers, but this is not of much use. Carbolized tow may be used for cancer cases to lie upon, and changed frequently. Wool, with salicylic acid, is sometimes used to cover the dressing of an offensive wound, or salicylic lotion for a warm water dressing. Slop sinks may be sluiced down with carbolic acid. *Water-closet pans* should be scrubbed with strong nitric acid, if they have been allowed to get at all offensive. Urinals, if allowed to become furred, must be sluiced out with boiling water, and then, if necessary, scraped with a knife all round and inside the grating. Also water-closet slop sinks. These all should be scrubbed with sand and chlorinated soda at least twice a week. In hospitals the head-nurse ought to mop-out and rinse-down the urinals every morning herself with a little bed-pan mop, and let boiling water run through; the same with the water-closet pans. The lavatory basins, when used, should be mopped-out every morning, and scrubbed at least twice a week with sand. There should be two mops—one new one for lavatory basins, appropriated when a little old to the bed-pans, and the old one replaced with new; the new small mop to hang over the lavatory basins, the old one to hang over the slop-sink for bed-pans; an old bottle-brush for the handles of bed-pans, a new bottle-brush, kept in the ward-kitchen, for bottles. Ordinary basins should be washed with tow.

3. **Precautions against finger-poisoning, &c.**—One of the most important points nurses have to be taught on beginning surgical ward-work (and, indeed, surgeons also,) is how not to poison their fingers. No good nurse will poison her own fingers any more than her patient's.

*The following rules should be strictly observed:*—

Pare the finger-nails close; keep them, as well as fingers and hands, scrupulously cleaned; anything which has soiled the fingers is a possible source of contagion to others and to yourself: an agnail, or crack, or scratch, or pin-puncture, is as likely to produce a poison-nest to others or to yourself, even more than an open wound or sore. Such poison-nests must be made harmless by first washing with pure water, next by applying styptic colloid, thirdly by putting on an india-rubber finger-stall. Immediately *before* beginning any dressing, and in every case *after* touching the patient, whether in dressing wounds, rubbing in applications, administering enemata, internal syringing, washing out eyes, ears, nose, mouth—dip the hands into watery solution of carbolic acid, 1 to 80, and then wash hands and nails carefully with carbolic soap. 'Dressing forceps,' or syringe, or whatever is used, to be dipped in solution of carbolic (1 to 80) *before* use as well as *after*. The teeth and joints of the 'dressing forceps' to be brushed clean. Remove soiled dressings with 'dressing forceps,' and not with the fingers; on no account scratch up adhesive plaster or other adhering dressing with the nails. Nurses of the old school will boast that they are not afraid. The fear of dirt is the beginning of good nursing. With all internal cases, keep the nails short, fill the same with carbolic soap, and carefully anoint the fingers you are about to use, especially the first and second fingers in attending on vaginal cases, with carbolic oil (1 in 20). Oil the tube or nozzle, &c., to be used for any internal appli-

cation, with carbolic oil (1 in 20). Otherwise the appliance used might convey contagious matter from one patient to another. Always use two basins in washing wounds, so as not to dip the fingers in dirty water. Catheters must be cleansed and disinfected, first with a stream of warm water, and then with a stream of watery solution of carbolic acid (1 to 40). Catheters of other material than silver should *not* be *soaked* in carbolic acid solutions, as the acid injures varnish and gum. Never 'blow down' towards the eye *first* instead of last, for so some lodgment will always be effected at the bottom. Never fail to take your own carbolic soap, with which you will be provided, in your own soap-tin, into the ward each morning and evening in your pocket. But take it out before beginning 'dressings,' as otherwise you put a dirty hand into your pocket. Always dry your cleaned fingers and hands on towels *not* used for any other purpose. After offensive cases, blow the nose and expectorate, and rinse mouth and throat with Condy and water, or with permanganate of potash, a few grains in water. Cuffs and sleeves and stuff dresses are possible carriers of contagious matter. Always change the apron and over-sleeves which you have worn about the sick before eating or drinking. Report immediately any scratch or agnail or sore you may have to the ward-sister; ask immediate advice after breathing in offensive air. Never go on duty in the morning without having taken a meal.

The nurse must be taught the nature of contagion and infection, and the distinctions between deodorants, disinfectants, and antiseptics.

Mischief done by students and dressers might have been saved, and valuable lives spared, even among surgeons, if such precautions had been always scrupulously observed by them.

4. **Food and Drink (Diet).**—The physician will tell us that, to give food and stimulants in the way, at the time, of the kind, with the cooking and preparing, that will best enable the poor enfeebled digestion to assimilate it, is one of the great nursing arts. No chemical rules can be given for this as absolute. The patient's stomach is the laboratory, and also the chemist. It is the sole judge of whether the physician's orders are right; and the nurse has to watch and tell him what the patient's stomach says. She must be of course trained and cultivated to understand what it says.

The patient's stomach sometimes craves, and assimilates too, what no rules would have prescribed for it. The nurse must ask the physician whether she may gratify these cravings. Sick-cookery should do half the digestion's work; and proper variety is essential. If a patient is sick after taking food or drink, or feverish, or faint, or torpid, it is often a symptom not of the disease but of the nursing. Indeed, how much of the suffering of illness, as well as of its danger, is the fault not of the illness but of the nursing, is well known to the skilful physician and surgeon.

The nurse, of course, has nothing to do with the prescribing of stimulants any more than of medicines. But life often depends—especially in fevers and severe surgical injuries—upon the nurse knowing how to follow the indications of the changes to be looked for in the patient's state given her by the physician, and to change the times of giving the stimulants accordingly.

The nurse must know how to make gruel, arrowroot puddings, egg-flip, drinks, good beef-tea, and other kinds of sick cookery, so as to please the patients' taste and vary their diet. People say 'fanciful patients' must be 'humoured.' So they must; but it is in order to excite the proper secretions of saliva and gastric juice necessary for digestion. Nothing should ever be cooked in the ward or in the patient's room.

But though 'sweet Jack Falstaff' says, 'A nurse is a cook,' the whole of the cooking must not be thrown on the nurse, if she is to nurse; and above all, if she is to eat, she must not be expected to cook for herself. But she will always be required not only to see that the patient's food and drink be as prescribed, but that it be well cooked, and punctually and well served. The physician considers that upon the nurse's power to give weak patients food in the way they like often depends their taking, or at least assimilating, any food at all.

She has also to feed, for example, fever-cases so that they can eat. The mere lifting-up of a patient in bed to give him food may terminate fatally a fever-case. The nourishment or stimulant ordered may have to be put into his mouth perhaps every half-hour—perhaps every five minutes—even during sleep, without rousing the patient—the test of a good nurse. The physician expects the nurse to be able intelligently to make the variations he prescribes in giving these things, especially during the night, according to the state of pulse and other symptoms, which she must know how to observe, in order to follow his conditional directions, upon which hangs the patient's life from hour to hour, often from minute to minute. In convalescence from typhoid fever, one single false indulgence has often induced a relapse and terminated a case fatally.

5. **Application of Remedies.**— The physician or surgeon requires the nurse—

To be able to apply leeches, externally and internally, in the best way; to dress blisters, burns, sores.

To administer stimulants and medicines as ordered, enemas and injections to men and women, and suppositories.

To manage trusses, appliances in uterine complaints; to pass the catheter—at least for women. The district nurse is often now required to pass the speculum, also the catheter for men, because there is no one else to to do it.

To use the best methods of friction to the body and extremities; to make and apply fomentations, poultices, and minor dressings, wet and dry and greasy; to syringe wounds; to syringe the vagina.

To manage helpless patients—fever, operation, and surgical cases—that is to move, to change them, to keep them personally clean, warm or cool.

The medical attendant will expect the nurse to maintain an exquisite cleanliness of the patient's whole person and skin, and, as in fever—the daughter of dirt—to clean herself the patient's teeth, gums, and tongue, with lemon-juice or white-of-egg beat to a froth. A nurse is no nurse who cannot wash or sponge a patient's

whole body without exposure or chill to any part. In typhoid and other fevers, this is now an essential part of the treatment.

To give food and stimulants to helpless patients—fever, operation, and surgical cases; to manage the position of such cases; to prevent or to dress bed-sores.

To make the sick-bed, and especially to make the bed with the patient in it; to change the under-sheet without moving the patient, as in fever and operation cases. The 'best way' includes, in this as in all other things, the doing them at the least expense to the patient's vital powers.

To prepare the bed for fever, for accidents, for ovariotomy, and various kinds of operations; to undress, handle, and put to bed accident cases.

To attend at and prepare for operations—including ovariotomy, lithotomy, hernia; to prepare patients for and manage them after operations and anæsthetics—and all this with the least call upon their small strength.

To be able to do the first thing in case of hæmorrhage, namely, compression by hand, by extemporary tourniquet and plugging.

To bandage all the various parts of the body, arm, leg, and chest (in Paris the *infirmiers* of military hospitals are made to practise all this, till not only it is done perfectly, but in a given number of minutes).

To make bandages of the various kinds used: T-bandages, double-headed, compound, 4- and 6-tailed, many-tailed, finger, ovariotomy, triangular, perineal, starched, and plaster-of-Paris, and other stiff bandages.

To make rollers, to line and pad splints, to make gutta-percha splints, fracture and chaff pillows (black flock fracture-pillows harbour dust), and sand-bags.

The nurse is sometimes now required to give subcutaneous injections, to use the galvanic battery, and to dry- and wet-cup.

She is required to be able to apply dry and moist heat, to give inhalations and use the spray-disperser; to apply cold, with the use of siphons and with ice; and antiseptic treatment.

**Observation of Patients.**—The physician and surgeon require every nurse to be able to observe correctly, and to report correctly, on the state or character of secretions, expectoration, pulse, skin, appetite; effect of diet, of stimulants, and of medicines; eruptions; the formation of matter; as to intelligence, with regard to delirium, stupor, &c.; as to breathing, whether quick or slow, regular or irregular, difficult, &c.; as to sleep, whether sound, starting, heavy, &c.; and as to the state of wounds. The physician also requires the nurse to be able to 'take' and to record the temperature, sometimes every quarter of an hour in critical cases—the pulse, the respiration; to measure and sometimes to test the urine for him. She will be required to make these observations—if possible still more accurately—for child-patients, who cannot tell what is the matter with them; to understand the management of sick children and children's wards, which need a yet more exquisite cleanliness. And children show a much more rapid change of symptoms for life or for death generally than adults. Children are the best air-test, the best test of sanitary conditions.

VI. **Other Duties.**—She must understand the management of convalescents—a whole department of nursing in itself—and the sooner a convalescent, especially a convalescent child, is removed from hospital to a country 'home' the better.

She must be competent for the charge of linen—a most important item of nursing, when we consider that on extreme cleanliness of bed and patient's linen—in other words, on linen and nurse, depends the not re-introducing disease into disease.

The physician considers that fever, above all other diseases, tests nursing power, and depends upon this for life or death. 'Dr. ——' (of St. Thomas's Hospital) 'doesn't think much of the nurse who loses a fever patient,' was said of that wise man.

**Night-nursing.**—The physician or surgeon requires the night-nurse to be as good as the day-nurse, or even better—for the most critical times of fever and severe surgical injury often occur at night, or in the very early morning. But quite the same kind of business capacity is not required in the night-nurse as in the nurse in day charge of wards. Night-nurses, to do their work well, must have at least seven or eight hours in bed where they can sleep undisturbed by day; (even horses in the New York 'Horse Hotel,' which work by night, have a separate dormitory to sleep undisturbed by day). They must have hot meals prepared for them when they come off duty in the morning, and before they go on duty at night; besides breakfast at 1 or 2 a.m. They must have one and a half or two hours' exercise. In a hospital they should be obliged to show their pass. It is rather more necessary for a night-nurse to be regular in her habits, if she is to be well and efficient, than for a day-nurse. And there appears no reason why nursing by night, if properly managed, should be more trying than by day. But regularity of habits, of meals, of sleep, of exercise, of personal cleanliness, is the *sine quâ non*. Occasional breaks or transfers to day duty may be necessary; or a night or two in bed every month for a night superintendent.

**Holidays.** — All nurses, especially night-nurses, must have holidays. A month in the year is not too much. Yet more do matrons and superintendents and all women filling nursing offices of great responsibility require an annual holiday if they are to maintain vigour of body and mind, and not to wear out prematurely. An occasional three months' holiday besides might be great economy.

**What a Nurse is to be.**—A really good nurse must needs be of the highest class of character. It need hardly be said that she must be (1) Chaste, in the sense of the Sermon on the Mount; a good nurse should be the 'Sermon on the Mount' in herself. It should naturally seem impossible to the most unchaste to utter even an immodest jest in her presence. Remember this great and dangerous peculiarity of nursing, and especially of hospital-nursing, namely, that it is the only case, queens not excepted, where a woman is really in charge of men. (2) Sober,

in spirit as well as in drink, and temperate in all things. (3) Honest, not accepting the most trifling fee or bribe from patients or friends. (4) Truthful—and to be able to tell the truth includes attention and observation, to observe truly—memory, to remember truly—power of expression, to tell truly what one has observed truly—as well as intention to speak the truth, the whole truth, and nothing but the truth. (5) Trustworthy, to carry out directions intelligently and perfectly, unseen as well as seen, 'to the Lord' *as well as* unto men,—no mere eye-service. (6) Punctual to a second, and orderly to a hair—having everything ready and in order before she begins her dressings or her work about the patient; nothing forgotten. (7) Quiet, yet quick; quick without hurry; gentle without slowness; discreet without self-importance, no gossip. (8) Cheerful, hopeful; not allowing herself to be discouraged by unfavourable symptoms; not given to depress the patient by anticipations of an unfavourable result. (9) Cleanly to the point of exquisiteness, both for the patient's sake and her own; neat and ready. (10) Thinking of her patient and not of herself; 'tender over his occasions' or wants, cheerful and kindly, patient, ingenious and *feat*. The best definition can be found, as always, in Shakespeare, where he says that to be 'nurse-like' is to be

> 'So kind, so duteous, diligent,
> So tender over his occasions, true,
> So feat.'

A patient wants according to his wants, and not according to any nurse's theory of his wants or 'occasions.' 'Tender over his occasions' she must be; but she must have a rule of thought: and this the physician or surgeon has to give her in his directions; which her training must have fitted her to obey intelligently, using discretion. The nurse must have simplicity and a single eye to the patient's good. She must make no demand upon the patient for reciprocation, for acknowledgment or even perception of her services; since the best service a nurse can give *is* that the patient shall scarcely be aware of any—shall perceive her presence only by perceiving that he has *no* wants. The nurse must always be kind, but never emotional. The patient must find a real, not forced or 'put on,' centre of calmness in his nurse. To call upon a patient by emotion for emotion is the most cruel, because useless, demand upon his strength. It is asking him to bear your troubles and your anxiety as well as his own. Suppressed emotion is as bad—it makes the nurse constrained. It is exposing the patient to both frost and fire. Half the battle of nursing is *to relieve your sick from having to think for themselves at all*—least of all for their own nursing.

FLORENCE NIGHTINGALE.

**NUTMEG-LIVER.**—A form of disease of the liver, the appearance of which on section somewhat resembles that of the cut surface of a nutmeg. *See* LIVER, NUTMEG.

**NUTRITION, Disorders of.**—The nutrition of the body, by which we understand the maintenance of its parts in a fit state to perform their functions, depends on three main factors—the supply of suitable food; the assimilation of food; and the prevention or control of waste. When any of these factors are disturbed disorders of nutrition result. If food be inadequate or unsuitable, other things being normal, general atrophy will be the consequence (*see* ATROPHY, GENERAL); and the same result will evidently follow if the organs of assimilation are at fault, or if waste be excessive, even though food be abundant. Hence cancer of the stomach on the one hand, and diabetes on the other, may be taken as the types of 'wasting diseases.' Increased supply of food, on the other hand, does not improve the nutrition or cause hypertrophy with the same certainty as want causes atrophy, causing increase chiefly of a single tissue, as shown in the articles on HYPERTROPHY and OBESITY.

Similar principles apply, *mutatis mutandis*, to local nutrition or the nutrition of parts of the body; in which the three factors are—the supply of nutritive material by the blood; the power of assimilation possessed by the tissues, depending on the condition of their minute elements; and the amount or rapidity of waste. Hence, as shown elsewhere, local atrophy results from obstruction in the blood-supply to a part; or from the inability of the part to appropriate nourishment, either through faulty innervation or the condition of the tissue-elements. In some cases excessive use, leading to waste, is also a cause of local atrophy. Increased blood-supply alone does not, on the other hand, by itself lead to hypertrophy. *See* ATROPHY, LOCAL.

When the disturbance of nutrition, however produced, causes a qualitative rather than a quantitative change in the tissue or organ, this change receives the name of DEGENERATION, of which there are several kinds (*see* DEGENERATION). Besides special kinds of degeneration, there is one general change which often results from impaired nutrition, namely, *softening*, but this is no longer regarded as a distinct process, since it differs, in its minute characters, according to the tissue which is affected. Induration, also, once regarded as among the general consequences of impaired nutrition, can hardly now be regarded as a distinct and substantive process; but may be understood in the sense of *fibroid degeneration*. In this place we can only refer to some instances of disordered nutrition, which are not precisely cases of atrophy or hypertrophy, but are yet dependent on disturbances of some of the factors of nutrition spoken of above. In these cases, where the blood-supply is not interfered with, the assimilative power of the tissues must be in fault, and this will depend upon either innervation or the condition of the tissue-elements. In some of these the nutritive disturbance leads to inflammation.

There are many curious instances of local changes of nutrition in which the blood-supply is quite unimpaired, and the cause has to be sought in some other disturbance, more especially one of the nervous system. Reasoning from certain well-marked cases of disorders of nutrition originating in the nerves, it may be plausibly conjectured that many other changes, and particularly many ordinary diseases, which we usually regard as idiopathic, may be similarly due to disturbance of nervous influence

Again, the nutrition of a part may be affected, not by direct nervous influence, but by reflex innervation, and thus depend upon the condition of some other organ. A very clear instance of a lesion of nutrition depending on the nerves is seen in the disease herpes zoster, and in some other skin-diseases, the distribution of which is obviously regulated by the distribution of certain nerves. The dependence of nutrition upon the nervous system is also seen in some instances of healing, as in the case of ulcers of the leg, pointed out by Mr. Hilton, where rapid healing follows the section of a nerve-branch leading to the ulcerated patch. On the other hand, the loss of vitality dependent on nervous disturbance is seen in the rapid formation of bed-sores on the sacrum in cases of paraplegia. The same conclusion must be drawn from the nutritive disturbances, beside the ordinary disturbance of the sensory or motor function of the nerves, which sometimes follow injuries to nerves. Thus injuries of the brachial plexus, not severe enough to cause actual paralysis of motion, may produce a state of swelling and hyperæmia in the fingers —the condition called 'glossy fingers' by Paget. Similar and more complicated changes have been observed as the consequence of gunshot wounds affecting the nerves. These cases, and such as these, have raised the question whether there are 'trophic nerves,' that is, whether, in addition to the fibres passing to the muscles and to the periphery, which are concerned in motion and sensation respectively, there are others distributed to the tissue-elements themselves, whose function it is to keep these elements in a proper state of nutrition. It is impossible to discuss this theory here; but we can only say that some of the phenomena which are thought to make necessary the theory of trophic nerves appear to be explicable by assuming the presence in the mixed nerve-trunks of some fibres derived from the sympathetic system. The connection of the sympathetic nerve-fibres with nutrition, though chiefly displayed through variations in the circulation, is undoubted. In the rare cases which have been observed in the human subject of lesion of the sympathetic nerve in the neck, a permanent change in the nutrition of the affected part is observed when the well-known vascular changes have passed away or become greatly modified. Lastly, it should be pointed out that in certain diseases of the spinal cord, for example, locomotor ataxia, affections of the joints, resembling chronic rheumatism, have been observed, which may be very plausibly, though not yet with certainty, ascribed to nervous derangements. On the strength of these cases it has been supposed that in other forms of rheumatic and rheumatoid disease, the distribution of the morbid changes depends upon the nervous system; but this must be regarded as quite theoretical. Still more uncertain are the theories which have been framed to explain the occurrence of internal diseases, such as inflammation of the lungs, &c., as a consequence of nerve-lesions.

When we find disorders of nutrition neither caused by changes in the distribution of the blood, nor connected with any nervous derangements, the fundamental change must be referred to the tissue-elements themselves; and it is probable that the number of disorders depending upon such changes in the minute tissue-elements is very large; and the field of 'elemental pathology' may be larger even than that of nerve-pathology or blood-pathology. Such an explanation is particularly reasonable when the changes are symmetrical on the two sides of the body, and when they are connected with advancing age; as, for instance, fatty degeneration of the cornea, turning grey of the hair, and primary degeneration of the walls of arteries. In these cases it seems unnecessary to suppose any implication of the nervous system, and disturbances of the circulation plainly do not account for the facts. It can only be supposed that the tissue-elements, like the organism itself, have their natural term of life, and that this term varies in different individuals, in whom, therefore, these failures of nutrition are merely the expression of the, more or less, premature old age of certain elements. These changes may be, and often are, the expression of the general condition of the whole body, which is more obvious in some parts than others, simply because the tissue-elements in these parts are older or less vigorous.

Treatment.—Having spoken of the chief causes of disorders of nutrition, it remains to consider whether there is any general treatment applicable to such disorders, independent of the special treatment proper to many of them as special diseases.

With regard to the general nutrition of the body, we can only refer to what has been said under the head of Atrophy, General, since hypertrophy is not a condition which practically requires treatment, unless exceptionally, as hypertrophy of a special tissue. With regard to local disorders of nutrition, the first and only generally applicable rule must be to remove, if possible, the local cause. If the cause is obscure, or, when discovered, cannot be obviated, the treatment must be guided by circumstances, but will usually be more of a *general* character. As an example of the removal of the cause of disordered nutrition, we have instances in which the phenomena of nerve-lesion above referred to have disappeared entirely on removing a fragment of lead or other irritating substance from the nerve-trunk. A more familiar instance is where the lower part of the leg is in a permanent state of malnutrition from stagnation of blood in varicose veins; œdema, eczema, subcutaneous induration, and ulcers may result. If, by suitable pressure or surgical treatment of the diseased veins, the circulation is rendered normal, all these morbid conditions will be healed. On the other hand, certain local disorders of nutrition can only be treated by improving the nutrition of the whole body. Cachectic children, for instance, may exhibit chronic conjunctivitis, bronchial catarrh, eczema of the flexures, and the peculiar sloughing sores of the fingers which have no distinct name, but are well-known indications of malnutrition. If, in place of, or in addition to, local treatment, we use general treatment, directed to improve the nutrition of the body, all these local disorders may entirely and perhaps simultaneously get

well, as they depend only upon the deficient power of resistance possessed by the tissues in general. J. F. PAYNE.

**NYCTALOPIA.** — Like hemeralopia this word has been used in two opposite and contradictory senses; one signifying *night-sight* or *day-blindness*; the other *night-blindness* or *day-sight*. According to the former, the etymology of the word is *νύξ*, night, and *ὤψ*, the eye; but according to the latter, it is *νύξ*, night, and *ἀλαώψ*, blind-eyed, which in its turn is derived from *ἀλαός*, blind, and *ὤψ*. The testimony of Hippocrates is cited in favour of the former meaning; but it should be remembered that the work in which the term occurs is not genuine, and there is, moreover, some warrant for the assumption that the text may not have been correctly copied. Galen, Aëtius, Paulus Ægineta, Pliny, and most of the best ancient authors, employ the word as meaning *night-blindness*, and we shall use it in this sense here. Nyctalopia may, therefore, be defined as disorder of vision in which objects are seen well, and without pain or discomfort, during the day, or by strong artificial light, but become more or less invisible in a deep shade, or by twilight. It is the opposite of hemeralopia. *See* HEMERALOPIA; and VISION, Disorders of.

**NYMPHOMANIA** (*νύμφη*, a woman, and *μανία*, madness).—A form of mental derangement in women, characterised by an insatiable desire for sexual intercourse. *See* SEXUAL FUNCTIONS IN THE FEMALE, Disorders of.

**NYSTAGMUS** (*νυσταγμός*, from *νυστάζω*, I nod).—An involuntary movement of the eyeball, due to clonic spasm of the muscles of the globe. It usually affects both eyes. The movement is generally horizontal, that is from side to side, and is then called *oscillatory*; but it may be *rotatory*, that is, round the optic axis, or *oblique*, when it is said to be mixed. It may be (*a*) congenital or infantile; (*b*) acquired; or (*c*) symptomatic of cerebral or spinal disease.

# O

**OBERLAND, the Bernese.**—Grindelwald, Gurnigel, Interlaken, Mürren, &c. Cool, bracing, mountain summer climate. *See* CLIMATE, Treatment of Disease by.

**OBESITY** (*obesus*, corpulent; from *ob*, by reason of, and *edo*, I eat). — SYNON.: Corpulence; *Polysarcia*; Fr. *Obésité*; Ger. *Fettsucht*, *Fettleibigkeit*.

DEFINITION.—This term is applied to a general state of disordered nutrition of the body, characterised by an excessive development of the adipose tissue, more especially in those situations where it is normally most abundant, namely, the subcutaneous, subserous, and intermuscular connective tissue.

ÆTIOLOGY.—*a.* **Predisposing causes.**—The influence of *heredity* in transmitting the liability to obesity is undoubted, and is a matter of common knowledge. *Sex* and *Age*.—That excessive corpulence is more common among women than among men is also well known. Several circumstances have been suggested to account for this, such as the menstrual functions of women, their less muscular activity as compared with men, and their frequently diminished oxidative power, due to poverty of red blood-corpuscles. Age appears to have considerable influence in determining this condition. Under a healthy regimen children get fat from birth, notwithstanding that at the same time the albuminoid ingesta must be largely employed in the construction of the rapidly growing tissues; and hence, at this period of life, the fat and amyloid food-stuffs are the chief source of the adipose deposit. How frequently are seen children improperly fed on excess of starchy matter, very fat, whilst their general nutrition is much impaired. A fat child is far from necessarily being a healthy one. At puberty there is frequently a diminution in weight, both relatively to the height and absolutely; but the contrary to this sometimes accompanies the establishment of menstruation, especially if the subject be very chlorotic—that is, with an enfeebled oxygen-carrying blood-power. After the age of forty, particularly in women at the climacteric, the influence of age markedly asserts itself. Even the manifestation of the hereditary tendency may be postponed until that period, and for women to become fat at that time is almost the rule. The perversion of nutrition now under consideration is, in some unknown way, curiously but distinctly associated with the degree of development of the sexual functions, and in an inverse direction. This is very noticeable in eunuchs and animals whose generative organs have been removed, and the part played by the cessation of ovulation has been already mentioned. Even during pregnancy, when ovulation is suspended, it is no uncommon occurrence for the subcutaneous fat to be increased in amount. *Race*.—Among certain races obesity appears to prevail, as for instance the Hottentots; and whilst amongst some, such as certain castes of Hindoos, the condition has been highly estimated, amongst others, as the Greeks and Romans, it was regarded as disgraceful. *Climate*.—Although very fat people are met with in all climates, there appears to be a special tendency to their predominance in low-lying, damp countries, whilst, with certain exceptions, they are less often seen in very hot and in mountainous districts.

*Nervous Influence*.—Since the nervous system so directly influences tissue-changes, it is not to be wondered at that certain nervous states favour obesity: it is common in idiots.

*b.* Determining causes.—Excess of *food* is the first of these to be mentioned. Whilst no doubt a large excess of food may lead to corpulency, it must be confessed that it very often does not do so, and extremely thin men are often large eaters. And, on the contrary, many women who become excessively obese have poor appetites. Nor does it seem in these different classes of cases, that the kind of food makes much difference. Some get fat, eat what they will; others do not, whatever the diet. *Drink.*—It is, however, usually the case that very fat people take a large amount of fluid food. How alcohol acts in the production of fat is not very clear. It is asserted that it does so by diminishing oxidation; but this is not the entire explanation, for the extent of obesity is far from being proportionate to the amount taken, and not unfrequently an excessive ingestion is not associated with corpulency. There would seem also to be something due to the form in which the alcohol is taken. *Exercise.*—Deficient muscular activity, by diminishing the amount of oxidation of tissue, favours obesity; and since, as a rule, the stouter the person the less capable is he of exercise, these two conditions react one upon the other, to the advantage of fat-production. *Disease.*—Exceptional cases of corpulence have followed recovery from fever, and extensive bleedings, even when there had been no predisposition; and a similar result has been met with after prolonged administration of mercurials and arsenic, which is perhaps to be explained by the deteriorating influence that these drugs are said to possess on the red-blood corpuscles.

Pathology.—Assuming that the current views on lipogenesis or fat-formation are known to the reader, it is sufficient here to state that from whatever source the fat of the body be derived, whether from the fatty, the amyloid, or albuminoid elements of the food, or from all, as is most probable, the fact of its being stored up as adipose tissue must be regarded chemically as an expression of deficient oxidation; a process which, if it had been more complete, would have resulted in the conversion of these elements into carbonic acid and water, to which the fat itself is reduced when it is subsequently used up in the economy. It is thus that the corpulence that frequently attends such morbid states as anæmia, chlorosis, hæmorrhage, some pulmonary and cardiac diseases, and alcoholism, is to be explained; since in all these diseases the oxygenising power of the blood is deficient.

The fat of the body in an average male adult constitutes about one-twentieth, and in the female rather more, of the total weight. It is not for $3\frac{1}{2}$ months after the commencement of development, that the adipose tissue is sufficiently differentiated to be distinguishable; it gradually increases in amount, being considerable at birth and up to puberty, when it often diminishes slightly; during maturity it increases, or the reverse, being very variable in amount; and during old age it decreases. During childhood the adipose tissue is more evenly distributed in the subcutaneous tissue than in later life, when fat tends to diminish on the surface in proportion as it becomes deeper-seated.

In the three situations in which the fat is chiefly deposited—namely, the subcutaneous, subserous, and inter-muscular connective tissue—there are certain areas which are preferred by it, as there are others which escape. Whilst the abdomen, buttocks, and back of the neck are especially prominent, the wrists, ankles, eyelids, scrotum and penis are free from fat. Beneath mucous membranes it is very unequally distributed. Fat is never seen beneath the peritoneal coat of the stomach or intestines, the parietal pericardium, or the visceral pleura; whilst the great omentum, which usually weighs about $\frac{1}{2}$-lb., may reach to 7 lbs. or 8 lbs., or, it is said, even 30 lbs.; and under the synovial membranes fat may be deposited to such an extent as to interfere with the movement of the joints.

The ordinary state of the organs found in very corpulent people is, that the lungs are small; the heart and the liver large, and infiltrated with fat; the gall-bladder containing only a little pale bile or mucus; the stomach large and muscular, but well-developed; the kidneys small; as also the spleen and lymphatic glands; and the pancreas largely developed.

Like many other conditions of disease, it is impossible to define the exact line at which a morbid obesity may be said to commence. All degrees of corpulence, indicated by such terms as 'stout,' 'embonpoint,' &c., occur, to which the notion of disease is wholly inapplicable. Nor, as will be seen, can the disturbance of function be taken in all cases as the measure of a morbid state, since the impairment of function is not always proportionate to the amount of fat.

As instances of extreme corpulency the following may be quoted:—

Daniel Lambert, who at twenty-three years old weighed 32 stone, but could walk from Woolwich to London. His subsequent maximum weight reached to 52 st. 11 lbs.

Edward Wright, 44 st.

Dr. Wardell records the case of a young married woman, who, at eighteen was thin and delicate, had no children, and lived well; she died at the age of forty-one; the thickness of the subcutaneous fat on the sternum was 4 inches, and midway between pelvis and umbilicus 8 inches. The heart weighed 36 oz., the liver 118 oz., and there were prolongations of fat from the omentum 1 to 4 inches long, as thick as a candle.

As illustrations of precocious obesity, cases are on record of a girl weighing 13 st. at the age of twelve years; and a boy weighing 8 st. 12 lbs. at three years. This boy had three teeth at birth, and twenty-six at thirteen months old.

Thus, in extreme cases, one-half, or four-fifths even, of the body-weight may be fat.

Symptoms.—The general appearance of a corpulent person scarcely needs description. The condition may be associated either with a hyperæmic or full-blooded, or with an anæmic state of body, and it is desirable to recognise this in view of treatment. Owing to the fatty infiltration of the muscular tissues, and the degeneration of the fibres, the muscular energy is diminished, this being especially noticeable in regard to the heart, the action of which is easily disturbed, and palpitation is a frequent symptom, accompanied by dyspnœa, induced by slight exertion. The affection of the voluntary muscles manifests it-

self in an indisposition to active exercise. The digestive power is often very well maintained, and this notwithstanding the frequent excess both in the quantity and in the quality of food indulged in. Periodical impairments are, however, frequent, and flatulence and constipation are often troublesome. The cardiac sounds are usually feeble and distant, though the reverse obtains when there is a hypertrophied ventricle. The pulse is full, or small and weak, according to the plethoric or feeble state of the individual. The mental activity is variable, and many external causes tend to modify it; but the temperament is proverbially 'easy-going,' indolent, and lethargic, especially after meals, although very frequently interrupted by attacks of peevishness and irritability, or by unusual somnolence and quiet. Examples, however, of considerable intellectual attainments are not unknown among the corpulent. The excretions are usually copious. Profuse sweating is induced by slight exertion, and the secretion of the sebaceous glands is abundant. The urine generally is acid, and contains an excess of uric acid. Partly from chafing, and partly from the excessive cutaneous secretions, intertrigo and other eruptions are apt to occur in the folds of the groin, below the mammæ, and in similar parts. The vessels share in the general malnutrition of the tissues, and atheroma of the arteries is often found, whilst the veins become distended and varicose, forming hæmorrhoids and varicocele. Depending upon these vascular changes are the congested and bloated appearance of the face, and the liability to headaches, vertigo, and giddiness. The sexual appetite is frequently deficient in both sexes, and sterility is common in women. Disturbances of sight and hearing are frequently noticed in fat people.

The condition of obesity, like other general perversions of nutrition, such as tuberculosis and rickets, most distinctly presents other characteristics than the mere signs and symptoms above enumerated. There are certain tendencies and liabilities which the state engenders; and intercurrent maladies come to possess special features. Periodically, the fat man ails without perhaps any obvious cause, and such ailments must be regarded as the expression of malnutrition of the tissues produced by the excess of fat. Among the more prominent of these affections is a proneness to catarrh of the respiratory and alimentary mucous membranes, and periodical 'colds' and diarrhœas are frequent. This is in great part due to the fact that the power of self-regulation of temperature, which the body possesses, is diminished by the thick layer of subcutaneous fat, which is a bad conductor of heat, and interferes with compensatory radiation. At the same time the plethoric condition, the hyperæmia, and the enfeebled circulation due to the weak heart, all tend to the same end, namely, a liability to congestion of the ill-supported tissues, such as the mucous membranes, with the results of such congestion in excessive secretion and other derangements of function.

The obese subject is quite as liable to the acute diseases as is the thin man; and these maladies run in him a singularly unfavourable course. The diminished power of heat-radiation increases the pyrexia; and the weak heart favours the establishment of the adynamic state. Such means for lowering the temperature as cold applications have but little effect through the thick fat; and aconite is contra-indicated by the pulse. But since the oxidising process in the corpulent is diminished, the temperature in the febrile state is rarely very high, and at the same time is but ill resisted.

The effective agent in lipogenesis, namely, deficient oxidation of the ingesta, especially the albuminoids, also favours the formation of uric acid, and hence the fat are often gouty. Saccharine urine (a condition which, whatever view be taken of its pathology, is manifestly a state of deficient oxidation of certain tissue-elements)—especially that form which is met with in those advanced in life—very frequently occurs in stout people. In 32 of 140 cases of diabetes observed by Seegen, obesity preceded the glycosuria.

Progress and Prognosis.—The progress of obesity is essentially chronic, and rarely, if ever, tends to other than increase of this state. Extreme fatness in the very young, as said, usually subsides; but the obesity of advanced life never does, unless any exhaustive disease should coexist, such as cancer or diabetes; and the latter by no means produces then the emaciation that it causes in young people. Obesity should, on the whole, be regarded as a grave matter, since very fat people rarely reach an advanced age; whilst a decrease of fat at middle age in a person hitherto stout should be regarded with suspicion.

In obesity death by syncope may result from an extremely fatty heart; from apoplexy, caused by rupture of an atheromatous vessel in the brain; or from bronchitis, with general œdema from cardiac dilatation.

Treatment. — Limited space prevents even an enumeration of the nostrums that a fanciful empiricism has suggested for the prevention or cure of obesity.

Recognising that accumulation of fat is a perversion of nutrition, which, if once established, and with a strong hereditary predisposition, cannot be cured, it follows that we should endeavour to prevent as far as possible its increase, by avoidance of those factors which pathology tells us are favourable to its development. The cardinal rule in any procedure that may be adopted is to avoid heroic treatment, for though thereby the fat may be diminished, the result may be attained by establishing a worse state of the body, if not one leading even to a fatal termination. The guides as to how far a given plan may be proceeded with are, first of all, the age and general condition of the patient, especially as regards the heart's power; and, secondly, the feelings and capability of the patient as the treatment is pursued. Each case must be treated according to circumstances, bearing in mind that the objects to be aimed at are to diminish the sources of the fat, and to increase the oxygen-carrying power of the blood and oxidising power of the tissues.

The diet must be regulated in quantity and quality. Since a healthy diet should consist of certain proportions of nitrogenous, amyloid, and fatty principles, and since from all these three substances fat may be formed in the body, the question arises which can be most advantageously diminished. Experience supports our patho-

logical knowledge in advocating a withdrawal as far as possible of fatty and starchy food, whilst at the same time a moderate increase in albuminoid matter is permitted; for with a fair quantity of the other food-stuffs, proteids increase tissue-change. It is on this principle that systems of dietary for the corpulent are founded, the best known of which bears the name of Banting, who for a year (1863) successfully followed out a plan laid down for him by Dr. Harvey, with the result of losing 44 lbs. in weight, and without the recurrence of corpulence when ordinary diet was resumed. There are many other cases recorded. Dr. Cheyne, who weighed 32 stone, reduced himself a third in weight, and lived afterwards in good health to the age of seventy-two (Dr. Wadd on *Corpulence*, 1822). Lean meats, sweetbreads, fish, except rich kinds, such as salmon and eels, clear soups, poultry, game, eggs, cheese, green vegetables, toast, gluten bread, fresh fruit, and pickles are allowable articles of diet. An average diet for an adult would be 12 oz. lean meat, 6 oz. rusks or gluten bread, 4 oz. green vegetables, 1 oz. butter, and tea ½-pint. Much difference of opinion exists as to how far water should or should not be freely allowed. Alcohol generally should be avoided, but especially spirits and beer, which must be absolutely forbidden, except on emergency; cider or the light dry wines, both white and red, diluted with water, are less objectionable. Tea and coffee are supposed to interfere with tissue-change, and therefore should be taken sparingly; and milk, from the quantity of fat it contains, is to some extent inadmissible.

Exercise, within the limits of the patient's powers, such as riding, walking, rowing, and gymnastics, is of great benefit, by directly inducing an increased oxidation of tissue, and improving the quality of the blood, and therefore its oxygen-carrying power. Cold-bathing, if well borne, is of advantage on similar grounds, but extreme sweating is unadvisable, and may be dangerous. Breathing compressed air, with the object of increasing the tissue-oxidation, has been recommended.

It is in carrying out a system rather than in devising one that the difficulty occurs. The regularity and restraint prove irksome to the patient, and are frequently broken. Hence it is that the regimen and spare diet of the various spas, such as Carlsbad, Marienbad, Kissengen, and Ems have great advantages, since at such places, and in such surroundings, the patient more readily and willingly pursues a given plan.

In the treatment of intercurrent diseases it is essential to remember the enfeebled resisting power of the patient, and the necessity for stimulants.

Among the many drugs that have been used, may be mentioned alkalies, iron, and iodine. Soap was formerly much employed, as much as three ounces being given daily with milk and lime water; and some of the good effects of the various 'waters' are ascribed to their alkaline properties, especially the alkaline aperients of the above-mentioned spas. Iron is an essential in those forms of corpulence associated with anæmia, and most satisfactory results follow its administration, as the health improves and the fat diminishes. Young chlorotic subjects benefit by this treatment, which may be advantageously carried out at some chalybeate spring, such as Tunbridge Wells, Harrogate, or Spa. The iodides, such as those of potash and iron, given in large doses, undoubtedly effect a reduction in the amount of fat, but not always with a corresponding improvement in health. So long as this does not suffer and the patient improves, the drug may be persevered in, but it is frequently very badly borne when taken in quantity. The preparations of *fucus vesiculosus*, the basis of certain quack remedies, appear to depend for their value on the iodine contained in them.

W. H. Allchin.

**OBSOLESCENT**, (*obsolesco*, I grow out of use).—A term applied to miliary tubercle, when instead of undergoing destructive changes, it becomes dried up, shrunken, and hard, and thus remains inert. *See* Tubercle.

**OBSTRUCTION, and OCCLUSION.**—Obstruction and occlusion of the different tubes and orifices of the body are mainly effected in three different ways:—first, by *blocking of a tube* by its contents; secondly, by *alteration in its walls*; thirdly, by *pressure from without.*

1. **Blocking.**—The first mode of obstruction is met with in most of the tubes of the body, and may be produced in various ways. The occluding mass may be composed of the normal contents of the tube; of these contents variously altered; or, lastly, it may be some foreign substance introduced from without. Examples of the first of these modes occur in the intestine, in cases of impacted fæces or intestinal concretions; in the biliary and urinary passages from calculi; in the ducts of glands from the products of catarrh or inspissated mucus; and in the blood-vessels from deposits of fibrin. Obstruction by foreign bodies may of course occur in all tubes in direct communication with the external surface, but even internal tubes are sometimes obstructed in this manner. As examples of this may be cited the occasional obstruction of the bile-ducts by hydatid cysts, or by the ascaris lumbricoides; of the pulmonary artery by hydatids; of capillaries by masses of bacteria; and of the pulmonary capillaries by air sucked in by a wounded vein.

2. **Parietal Changes.**—Obstruction of tubes from alteration in their walls is the most common cause of the various forms of permanent stricture, and may arise from many different conditions. First, in those tubes whose walls are muscular, it may be the result of spasm. This form of obstruction is usually only of temporary duration, and is probably not of very frequent occurrence. It is supposed to take place in the urethra and the bile-duct, but the most important instances of it are met with in the respiratory and vascular systems. In the former we have examples in spasmodic closure of the glottis, and also in the narrowing of the bronchial tubes in spasmodic asthma; in the latter in the obstruction by spasm of the small arteries of the base of the brain, to which the initial phenomena of the epileptic seizure are ascribed. To a similar spasmodic occlusion of the arterioles of the lungs Dr. George Johnson ascribes many of the

phenomena of cholera. To a more prolonged spasm of the blood-vessels the gangrene produced by ergot has been attributed.

Obstruction from more permanent alterations in the walls of the tubes may be produced, first, by acute inflammatory swelling and œdema, and by the formation of false membranes; and secondly, by chronic inflammatory thickenings and cicatricial contractions. These form the non-malignant permanent strictures, as of the urethra, œsophagus, pylorus, and intestines. Thirdly, the growth of some malignant or other tumour in the walls of tubes may lead to the same result. This form of stricture is especially common in the digestive canal, from the pharynx downwards.

3. **External Pressure.**—Lastly, obstruction and occlusion are often the result of pressure from without. This pressure may be exercised by a tumour of some kind, or by enlargement of an organ, as, for example, the obstruction of the trachea produced by an enlarged thyroid body. Or the pressure from without may be produced by the effects of inflammatory processes occurring in the surrounding parts. We have examples of this in occlusion of the intestine by fibrous bands, and in obstruction of the tubuli uriniferi of the kidney by the cirrhotic process. Other examples of pressure from without, causing obstruction, occur in displacements of the intestine in hernia, with which may be classed the various forms of volvulus.

Effects.—The effects of obstruction and occlusion differ, of course, according to the tube or orifice affected. They are in part due to the arrest of function of the tube, and in part are purely mechanical. The most general mechanical effect is dilatation of the tube behind the seat of the obstruction, owing to the accumulation of its contents (*see* Dilatation), and arrest of function beyond it. When these contents are themselves irritating, or when the disturbing cause also constricts the blood-vessels, ulceration, or gangrene and perforation, are liable to occur. The other effects are mainly due to the backward pressure of the accumulation. In cases where the tube is the duct of a gland, the ultimate effect is to arrest the secreting function, and cause atrophy of the gland. This is attended by cessation of any further accumulation; and sometimes complete absorption of the previous accumulation takes place, and the dilated duct shrinks and becomes completely atrophied. Examples of this series of changes occur not infrequently in the ureter and kidney. W. Cayley.

**OCCUPATION**, Ætiology of.—*See* Disease, Causes of; and Public Health.

**ŒDEMA** (οἰδέω, I swell).—Synon.: Fr. *Œdème*; Ger. *Œdem.*—A dropsical effusion in the cellular tissue, whether subcutaneous, submucous, subserous, or in the interstices of organs. *See* Dropsy.

**ŒSOPHAGUS, Diseases of.**—Synon.: Fr. *Maladies d'Œsophage*; Ger. *Krankheiten der Speiseröhre.*—The diseases of the œsophagus may be considered in the following order:—

1. **Œsophagitis.**—Inflammation of the œsophagus.

Ætiology.—Inflammation of the œsophagus, arising in its structures and confined to it, is an affection of rare occurrence; or it may be that it offers so few marked symptoms that but small attention is paid to it, and it never comes before the physician. But by no means uncommon is the extension of inflammation to the œsophagus from neighbouring structures. Thus, a catarrhal inflammation of the throat and fauces may pass down the œsophagus. In children thrush has been seen to extend into the gullet, setting up a certain amount of inflammation; and the same holds good with regard to diphtheria and croup. Where organic disease of this organ exists, a certain amount of inflammation is liable to be set up. But by far the most common causes of acute œsophagitis are the ingestion of irritating or corrosive substances, such as boiling water, alkalies, or acids; and mechanical injury from the introduction of foreign bodies.

Symptoms.—Somewhere in the line of the œsophagus pain, varying in intensity, of a burning or lancinating character, is complained of, at times so severe as to induce vomiting. This pain is rendered intensely acute by all attempts at swallowing. Even the passage of the saliva is sufficient to set it up, and hence it is that this fluid is seen dribbling from the mouth of the child who is the subject of this disorder. Thirst is a usual accompaniment of œsophagitis; but rather than endure the agony of swallowing fluids, the individual will put from him all fluids, however bland. If the attendant insist upon an effort being made to swallow some sustenance, most usually this is speedily rejected, accompanied with much viscid mucus, flakes of lymph, membranous shreds, and sometimes blood or pus. The amount of fever and constitutional disturbance is in proportion to the intensity of the inflammation.

Prognosis.— If simple, acute œsophagitis usually terminates in resolution, and somewhat speedily. If it be due to the passage of acrid or hot substances, ulceration of the œsophagus may result; or simply a permanent thickening of the coats of the tube, whereby its calibre is reduced, and stricture is the result.

Treatment.—It is best to abstain from all attempts to give nourishment in the ordinary way, and to rely entirely upon nutritive enemata till the acuteness of the affection has passed. Ice may, however, be given to the patient to suck, if it prove agreeable to him. For the relief of the pain warm poultices may be applied externally, or opiate fomentations. Opium may be administered either by enema, or subcutaneously. The state of the bowels must be attended to.

2. **Ulceration.**—Ætiology.—This affection, as we have already seen, may arise as the result of the passage of irritating fluids through the œsophagus. More commonly it is brought about by the swallowing of certain pointed or angular bodies which stick in the gullet, and cannot be dislodged, or before their removal have eroded the mucous membrane and produced ulceration. Simple ulcer and perforating ulcer of the œsophagus have also been described; they are similar to those which are observed in the stomach, but are of rare occurrence.

Symptoms.—These are similar to the phenomena described under œsophagitis, only the pain is more localised, and is more generally referred

to a circumscribed spot between the scapulæ in the back, at the top of the sternum, or in the præcordia. The same difficulty in swallowing is experienced, and, on account of the slowness of the ulcerated surface to heal, is much more protracted, so that the patient emaciates rapidly, and death from starvation has even been known to occur. In the perforating variety a communication may be established between the œsophagus and one of the bronchi—more likely the left, the pleura, or the pericardium. Auscultation may reveal a change of tone in the sound of the swallow, it being more dead in quality than in health. The bolus swallowed seems also as if it were diminished in bulk, but much elongated, so that it takes longer to pass the ulcerated spot than it does at any other portion of the tube.

Prognosis.—This must be founded on the nature of the ulcer, but it is always serious.

Treatment.—Not much reliance is to be placed upon medicinal treatment. The patient's strength must be sustained by the liberal use of generous diet if he can swallow, or by nutrient enemata. It may be possible to pass into the stomach a small-sized œsophageal tube (catheter No. 15) and, by attaching it to the stomach-pump, thereby introduce plenty of nourishment. Stimulants will also most likely be called for. Ice may be freely allowed. Local application of nitrate of silver, tannic acid, borax, and other agents, by means of bougies, has been advised.

3. **Dilatation.**—Dilatation may affect the œsophagus in its entire length, but more commonly involves merely a portion of the tube, as is frequently observed in cases of stricture of the œsophagus. In addition to this, sacs are met with in the walls of the canal, which communicate with it. These diverticuli are usually formed by the distension of all the coats of the œsophagus, but sometimes by the mucous membrane alone becoming dilated, and pushed between the other coats. The *causes* which give rise to this condition, in addition to stricture, are the lodgment of some foreign body in the walls of the œsophagus (this is one of the most frequent origins of the diverticula), and paralysis of the walls induced by chronic catarrh.

Symptoms.—These are not marked. If the dilatation be idiopathic, and involve the whole length of the tube, nothing very abnormal will be present to lead to the discovery of this condition. If it be secondary, dependent upon stricture, then in addition to the symptoms described under that head, it will be observed that the food, after it has been swallowed, is much longer retained than formerly. There is also experienced a sensation of fulness, which may sometimes be perceptible to vision, at the point above the stricture, and this is accompanied by a desire to relieve the sensation by vomiting, which sooner or later occurs, spontaneously or induced by the patient himself, and affords great and immediate comfort. In the case of diverticula, when of some size, the symptoms are very similar to those above described. In addition, it may be noticed that a very bad odour is given off from the mouth of the patient, due to the retention and decomposition of the food in these pouches. According to their site, tumours, varying in size as the individual has more or less lately been partaking of food, may be observed. These may sometimes interfere with respiration or circulation. Auscultation in the case of simple dilatation indicates that no obstruction to the passage of the bolus exists, and there is no prolongation of the time it takes to pass into the stomach. But an alteration in the vigour of the peristaltic action is observed. There is a deficiency or entire loss of the contraction of the muscles, and the gradual transmission of the bolus onwards is no longer heard, but it appears to run or drop at once into the stomach. It is generally believed that men are more subject to this affection than women; and it is met with in the decline of life.

Treatment.—Treatment is of no avail for dilatation of the œsophagus, except so far as to remove the cause, if possible, and to treat symptoms.

4. **Stricture.**—This affection may be the result of either of the two first-named disorders; or of a changed condition of the walls of the œsophagus, brought about by the existence of some new growth, such as that resulting from cancer or syphilis. Further, contraction of the œsophagus may be due to the presence of a tumour or other growth pressing upon, and so narrowing its calibre. Or, finally, it may be simply functional in its nature, giving rise to temporary obstruction, known as *spasm* (*œsophagismus*) and functional *paralysis* of the œsophagus.

Symptoms.—Organic stricture of the œsophagus may have existed for some time before the patient or his medical attendant realises the gravity of the complaint, because the symptoms develop themselves only very gradually. The most noticeable of all is the difficulty in swallowing. At first this may be merely occasional, and only perceived when a tolerably large bolus is attempted to be passed down the gullet; but gradually the difficulty increases, and it is now not only confined to the attempt to swallow solids, however finely masticated, but semi-solids give rise to the same sensation as if the food never passed a certain point, this point being usually referred to the manubrium sterni, at the upper or lower portion, wherever the stricture is situated. If the patient, by dint of great resolution and perseverance, overcome the difficulty to such an extent as to swallow some food, the first morsel passed being always the greatest trial, it may be retained for a time, but is ultimately rejected. This desire to get rid of the food swallowed increases to such an extent, that all aliment is regurgitated, rather than vomited. The rejected matter consists of the food, but little altered, largely mixed with mucus, or sometimes with a little blood and pus. The reaction is always alkaline. Finally the dysphagia becomes so marked that even the attempt to swallow liquids is given up as hopeless. Coincident with the advance of this dysphagia does the emaciation progress; the abdomen falls in; and the patient dies from starvation. The passage of a bougie will definitely settle any doubt as to the existence of an organic stricture, besides affording information as to its site, extent, and form; but the operation must not be performed without due consideration, as it has happened that an unrecognised aneurism has been opened by this instrument. Auscultation will also aid in

the diagnosis. It will reveal the same slowing of the passage of the bolus already referred to, and the same elongation of it. In addition, if the stricture be very narrow, then the food will be heard to pass through it with difficulty and with a creaking sound; while if it be narrower still, particularly if the food be fluid in its consistence, 'it eddies as it were in a funnel, with a prolonged resonant gurgle,' as described by Allbutt.

Spasmodic stricture of the œsophagus differs from the organic form in the suddenness with which the dysphagia comes on; its paroxysmal nature; its not unfrequently being but one of the many symptoms of hysteria; its occurrence in young anæmic females, or hypochondriacal men; and though dyspepsia may be complained of, and even prove an exciting cause, still emaciation does not exist. The point where the impediment to the passage of the food is experienced is usually at the upper part of the œsophagus or pharynx. Occasionally pain is complained of on attempting to swallow, and food taken is sometimes ejected. But the spasm soon yields, and food finds its way into the stomach. The difficulty in swallowing is much increased by the attempt being witnessed by sympathising friends, and a stern command to cease from such frivolous efforts often succeeds, to a surprising degree, in overcoming the dysphagia. On introducing a bougie, it will of course be stopped if the spasm exists at the moment; but gentle, careful, continuous pressure will ultimately cause the spasm to give way, and thus its true nature will be revealed.

Prognosis.—The prognosis in cases of real organic stricture cannot be otherwise than always grave. If it be due to cancerous growth, then it must necessarily be most unfavourable. Spasmodic stricture is very hopeful.

Treatment.—The treatment appertains more to the domain of surgery than of medicine. In the case of organic stricture, the frequent passage of bougies of varying size often proves valuable, except in the case of cancer, when it should never be attempted. Diet must be attended to, the state of the stomach looked to, and dyspeptic indications combated. If food cannot be swallowed a small catheter may be introduced through this stricture, and the patient fed by the stomach-pump; or nutrient enemata may be administered. For the spasmodic variety, the general system must be braced, tonics prescribed, and the usual anti-hysterical remedies ordered.

5. **Morbid Growths.**—By far the most common form of growth in the œsophagus is cancer. Occasionally fibroid tumours are seen, either as such, or as polypi, situated about the level of the cricoid cartilage. When carcinomatous, the growth may be any of the usual varieties of cancer; and it will frequently be found to affect the upper third, more commonly the lower third, and very rarely the middle of the gullet. It commences in the submucous tissue, speedily involving the other coats of the tube. From this it may extend to other organs, and perforation of the trachea, bronchi, aorta, or pericardium may take place.

Symptoms.—Confining the attention to cancer of the œsophagus, this disease may well be suspected if, in an individual above middle age, gradually increasing dysphagia be complained of; if symptoms of stricture be pronounced; if pain be experienced, especially of a lancinating character, about the spine and shoulder-blades; if nausea and retching be observed, together with irritating cough, and occasional hiccough; if the patient continue to emaciate, and present the dirty greenish-yellow complexion common in cancerous cachexia, together with enlargement of lymphatic glands: and most certainly shall we be confirmed in our diagnosis if, on examination of the vomited matters, cancer-cells be seen.

Prognosis.—The prognosis is of the worst description. The patient gradually becomes exhausted, and dies of inanition.

Treatment.—Treatment can be merely palliative. It consists in relieving the pain by narcotics; and endeavouring to sustain the patient's strength as long as possible.

Claud Muirhead.

**ŒSTRUS** (*οἶστρος*, a gadfly).—Synon.: Fr. *Oestre*; Ger. *Bremse*.—A genus of dipterous insects, called gadflies, the larvæ of which, vulgarly known as maggots or bots, live parasitically in man and animals. The ordinary human bot, *Œstrus hominis*, is of rare occurrence in England, but is not unfrequently met with in warm countries, especially in South America. The larva of the gadfly of the ox, *Œstrus bovis*, also occasionally attacks man. Dr. J. M. Duncan has recorded an interesting case of the latter kind (*Edinburgh Monthly Journal*, 1854), and Bracey Clark long previously noticed a similar instance. Cases of *Œstrus hominis* were either described or noticed by many earlier observers, amongst whom were Linnæus, Gmelin, Rudolphi, Olivier, Gill, Howship, and Treherne. The writer is in possession of full particulars of a case forwarded to him, with the parasite, by Mr. Higginson of Liverpool. It occurred in a boil at the back of the thigh. A third species of human bot, *Œstrus guildingii*, from Trinidad, is described by Guilding; besides which, nearly a score of other similar cases have been placed on record by various authors who were not able to identify the species.

True maggots and other bot-like larvæ are continually encountered in medical practice. As a rule, their identification as species can only be determined by skilled entomologists. Some forty years ago Mr. Hope referred the forms then known to upwards of twenty separate genera of insects (*London Medical Gazette*, 1837-38). Amongst cases of insect larvæ possessing more than ordinary interest we may particularise the following:—1. Several cases in which the larvæ of the coleopterous insect Blaps (*B. mortisaga*) passed from the stomach and intestines. In Pickell's celebrated case 1,206 larvæ were found, besides several of the full-grown insects, which are popularly known as the churchyard beetle. The writer recorded a case (*British Med. Jour.*, 1877), from the practice of Dr. Horne, of Barnsley, where a living larva was passed by an infant. 2. Numerous cases of the larvæ of *Anthomyia canalicularis*. Several of these have occurred in the writer's practice. 3. In Hope's list (*loc. cit.*) nine cases of mealworm are given (*Tenebrio molitor*). 4. The occurrence in the

human body of the maggots of various species of fly has frequently been noticed (*Musca domestica, M. carnaria, M. sarcophaga, M. vomitoria*, &c.). 5. In several instances, the so-called rat-tailed larvæ (*Helophilus*) have been passed *per anum*. One such case was brought under the notice of the writer by Mr. Noot; and a more recent instance has occurred in the practice of Dr. W. H. S. Westropp, at Lisdoonvarna, Ireland. The writer identified the parasite in both cases. 6. The late Dr. Livingstone, when in Africa, was attacked in the leg by a small bot-like larva, which Dr. Kirk removed by incision. The specimen was presented to the writer, and is now preserved in the museum of the Royal College of Surgeons (*Catalogue of Entozoa*, No. 196). In actual practice it is not uncommon to find the larvæ of various species of moths (*Noctuæ*), either in the night-stool or chamber-utensil; these, for the most part, being accidentally introduced. In like manner the maggots of various butterflies and other insects, are often passed, having been previously swallowed along with food. Lastly (7), we may refer to the horrible habits of the larvæ of the golden fly (*Lucilia hominivorax*). This insect, according to M. Coquerel, is particularly destructive to the convicts of Cayenne. The larvæ, hatched from eggs previously deposited in the mouth and nostrils of the victim, penetrate and devour the living tissues, after the manner of ordinary maggots in putrid flesh. According to M. Bouyer (*Tour du Monde*, 1866), the majority of the cases prove incurable. Other species of *Lucilia* have the habit of attacking the eyes, mouth, and nostrils of toads and frogs, the maggots eating into the tissues of the living batrachians. Dr. McMunn (of Wolverhampton) and the writer have seen instances of this, and have confirmed the observations of Herr Boie, and of M. Girard, M. Moniez, and others.

Treatment.—As regards the treatment of intestinal insect-parasites, ordinary purgatives, salines, and vermifuges, especially turpentine, will usually dislodge them; whilst for those that occur in wounds or ulcers at or near the surface, nothing is better than the application of carbolic acid solution. *See* Entozoa. T. S. Cobbold.

**OEYNHAUSEN, or REHME, in Germany.**—Gaseous thermal salt waters. *See* Mineral Waters.

**OFEN, in Hungary.**—Sulphated waters. *See* Mineral Waters.

**OÏDIUM ALBICANS.**—A vegetable parasite, associated with aphthæ or thrush. *See* Aphthæ.

**OINOMANIA** (*οἶνος*, wine, and *μανία*, madness).—A synonym for dipsomania. *See* Dipsomania.

**OLD AGE, Signs of.** *See* Senility.

**OLFACTORY NERVE, Morbid Conditions of.**—The principal morbid conditions that occur in connexion with the nerve of smell are the following:—

1. **Olfactory Hyperæsthesia.** Synon.: Hyperosmia.

Defintion.—Increased sensitiveness of the olfactory nerve.

Ætiology and Symptoms.—This condition is seen in the increased nervous sensibility which results from chronic debilitating illness. It occurs also in hysteria, in which remarkable, almost animal, acuteness of the sense is sometimes present, so that not only objects but persons have been discriminated by this means. In insanity the same condition is sometimes seen. It is usually associated with, and has to be distinguished from, an altered appreciation of odours, shown in the abnormal enjoyment of or disgust at the odours which are recognised with natural or preternatural acuteness.

Treatment.—The condition rarely calls for special treatment.

2. **Subjective Sensations of Smell.**—Subjective sensations of smell occur from central disease, or from irritation of the nerve of smell. In the insane olfactory hallucinations occur, though less commonly than those of the optic or auditory nerve. Schlager met with them in five cases out of six hundred. In epilepsy subjective sensations of smell occur as occasional prodromata of fits, and the disease in these cases probably involves the olfactory centre in the anterior part of the temporo-sphenoidal lobe. It was so in a case of tumour recorded by Sander. Irritation of the nerve, from meningeal disease or injury, also, in rare cases, causes olfactory hyperæsthesia. Dr. Quain has recorded an interesting case of perityphlitis, in which an apparently subjective sensation of a foul odour was persistently complained of by the patient, until evacuation of the contents of the abscess, when the supposed smell completely disappeared.

3. **Perversion of the Sense of Smell.**—Synon.: Parosmia.—This is a rare condition which occasionally results from irritation of the nerve or central organ. In a case recorded by Legg, some time after an injury to the head all substances 'tasted' of gas or paraffine, and there was marked diminution in the acuteness of the sense of smell.

4. **Olfactory Anæsthesia.**—Synon.: Anosmia.

Definition.—Loss or diminution of the sense of smell.

Ætiology.—The causes may be local changes in the organ of smell; disease of the nerve; or disease of the centre.

*a.* Among *local* causes may be mentioned the following:—(1) acute and chronic catarrh of the olfactory mucous membrane, the latter causing thickening; a condition sometimes produced by excessive snuff-taking. (2) Dryness of the mucous membrane, as in cases of destruction of the external nose (Notta), or in paralysis of the fifth nerve. (3) Occlusion of the passage by polypus, preventing the access of air to the olfactory region. (4) Impaired access of air consequent on facial paralysis. The loss of the power of dilating and keeping expanded the nostril prevents a due quantity of air being drawn through the nasal passage; and, moreover, the loss of power of compressing the nostril in 'sniffing,' prevents the air being directed into the olfactory region. (5) In rare cases loss of pigment in the nose, consequent on general

loss of pigment, has appeared the cause of loss of smell.

*b. Damage to the olfactory nerve* may result from injury or disease. It is not an uncommon result of blows or falls upon the head, and it is probable that in these cases the delicate olfactory nerves are torn from the bulb (*see* Nose, Diseases of). The bulb, or tract, may also suffer in adjacent disease, as tumour, abscess, caries of the bone, and meningeal changes, especially syphilitic. Spontaneous atrophy of the olfactory bulbs occasionally occurs in old age (Prévost), and has been met with in younger persons in the 'essential anosmia' of Notta.

*c.* In *cerebral disease* the sense of smell is sometimes lost. It may be impaired in so-called functional disease, as in hysteria, and in degenerative disease, as paralytic dementia. It is occasionally lost in organic disease involving the roots of the olfactory nerve. Unilateral anosmia has been met with in cases of aphasia (Hughlings Jackson), an association which is explained by the passage of the external root of the olfactory nerve past the island of Reil to the anterior part of the temporo-sphenoidal lobe.

It is to be remembered that the olfactory nerves are sometimes congenitally absent.

Symptoms.—The evidence of anosmia is the loss of the perception of odours. This may be partial or complete, according to the extent of involvement of the nerves. It may be lost on both sides; or when due to degenerative changes, on one side only. When due to organic brain-disease it is lost on the side on which the cerebral lesion is situated.

Diagnosis.—The diagnosis presents little difficulty. The affection is commonly complained of, but often as 'loss of taste,' the diminished perception of *flavours* being more obvious to the patient than the loss of smell. The sensations included under the term 'flavour' are, it need hardly be said, really olfactory and not gustatory. In examination, care must be taken to employ only substances—as aromatic oils, &c.—which affect the olfactory nerve, and not acrid substances, as ammonia and acetic acid, which stimulate also the fifth nerve.

Prognosis.—The prognosis in anosmia is favourable when due to a local cause, but when there is reason to suspect injury or disease of the olfactory nerve or centre, recovery is improbable.

Treatment.—Anosmia, as a symptom, rarely calls for treatment, which should be directed to its cause. Sometimes local stimulation is of service; and occasionally counter-irritation, by blisters to the neck, has appeared to assist recovery. In hysterical cases faradisation of the nasal mucous membrane has been recommended; but the olfactory nerve itself is not accessible to electrical stimulation. W. R. Gowers.

**OLIGÆMIA** (ὀλίγος, small, and αἷμα, blood). Deficiency of the total amount of blood in the body. *See* Blood, Morbid Conditions of.

**OMAGRA** (ὦμος, the shoulder, and ἄγρα, a seizure).—Synon.: Fr. *Omagre*; Ger. *Schultergicht*.—A name for gout in the shoulder. *See* Gout.

**OMENTUM, Diseases of.** *See* Peritoneum, Diseases of.

**ONANISM** (Onan).—A synonym for masturbation. *See* Masturbation.

**ONYCHIA** (ὄνυξ, the nail).—An inflammatory affection of the matrix of the nail. *See* Nails, Diseases of.

**ONYCHOGRYPHOSIS** (ὄνυξ, the nail, and γρυπὸς, curved).—This term is applied to curvature of the nails; and, more particularly, to the oblique elevation of the nails from their matrix by the accumulation beneath them of crude cell-substance, which forms a kind of wedge, and crumbles away upon desiccation. *See* Nails, Diseases of.

**ONYCHOMYCOSIS** (ὄνυξ, the nail, and μύκης, a fungus).—Parasitic disease of the nails. *See* Epiphytic Skin-diseases; and Nails, Diseases of.

**OPHIASIS** (ὄφις, a serpent).—A form of alopecia areata, which assumes a serpentine figure, either by creeping onwards, or by the blending of two or more of the circular discs. *See* Baldness.

**OPHTHALMIA** (ὀφθαλμὸς, the eye).—Synon.: Fr. *Ophthalmie*; Ger. *Ophthalmia*.—A general term which might be used to express any morbid condition of the eye, but which is restricted by custom to the forms of inflammation which originate in the superficial structures of the organ, such as the varieties of conjunctivitis, or the phlyctenulæ which sometimes appear upon the cornea, and may give rise to shallow ulcers. Thus we have mention by authors of *infantile*, *catarrhal*, *contagious*, *purulent*, and *strumous* or *phlyctenular*, ophthalmia. *See* Eye and its Appendages, Diseases of.

**OPHTHALMITIS** (ὀφθαλμὸς, the eye).—Synon.: Panophthalmitis; Fr. *Ophthalmite*; Ger. *Augenentzündung*.—A term which has been used to express inflammation affecting the whole of the structures of the eyeball, superficial as well as deep. Such a condition is most frequently seen after operations upon the eye, and was described by the late Dr. Jacob as *eyeballitis!* *See* Eye and its Appendages, Diseases of.

**OPHTHALMOSCOPE** (ὀφθαλμὸς, the eye, and σκοπέω, I examine).—Synon.: Fr. *Ophthalmoscope*; Ger. *Ophthalmoskop*.

The ophthalmoscope is an instrument for lighting up the interior of the eye, in such a manner as to render the contained structures clearly visible.

Description.—The first ophthalmoscope was invented about 1847, by the late Mr. Charles Babbage, who laid it aside because an ophthalmic surgeon to whom he showed it, and who failed to perceive its probable utility, afforded him no encouragement. In 1851 another form of the instrument was invented by Helmholtz; but, in 1852, Babbage's original form was re-invented by Ruete, and this, with a few unimportant modifications, has ever since held its ground in practice. It consists, essentially, of a slightly concave mirror, with a small central perforation; or, if the mirror be of silvered glass, with the silvering

removed from a small circle in the centre. A mirror the size of a shilling is large enough for all practical purposes, and a central aperture of not more than 2 or 3 millimètres in diameter is better than a larger one. The mirror may be attached to a handle of any proportions preferred by the owner, or may be left without one; but it must be accompanied by certain auxiliary convex and concave lenses, the uses of which will be presently explained. The focal length of the mirror is usually about 8 inches.

Method of Use.—In order to learn the use of the ophthalmoscope, the beginner will do well to avail himself of a contrivance called Perrin's artificial eye, or of the more elaborate one lately designed by Landolt. The former consists of a small hollow sphere of metal, to represent the eye, closed in front by a lens, which can be changed at pleasure, and behind by a door for the insertion of pictures of various healthy and diseased conditions of the retina. When an artificial eye is not available, the learner should take the patient into an obscurely lighted room, and should stand or sit facing him, with the two heads upon the same level. A gas or oil flame—preferably, from its greater steadiness and superior illumination, that of an argand burner—is then placed upon the same level as the eye which is to be examined, on the same side of the head, and a little behind it, so that no direct light shall fall upon the cornea. The observer, commencing with his face exactly opposite that of the patient, and about eighteen inches distant from it, places the back of the ophthalmoscope mirror against his eye, using preferably that which is opposite to the eye to be examined, the right eye for the patient's left, and *vice versâ*. The patient is directed to look as if at a distant object, over the shoulder of the observer which is most remote from the eye under inspection, thus looking over the observer's left shoulder when the right eye is being examined. In this position, the observed eye is turned a little towards the nose; and the optic nerve-entrance, which is somewhat on the nasal side of the posterior pole, is brought opposite to the pupil. Looking through the mirror-aperture, the observer directs the light of the flame, reflected from the polished surface, in such a manner that it falls into the pupil of the observed eye; and this light, returning from the eye, reaches him through the perforation. It exhibits the cavity of the eye illuminated, but, as a rule, shows no objects, but only the pupil as a reddish or yellowish circle. In order to see the contained structures, two methods are employed, the *indirect* and the *direct*; the former of which gives the better general view of the fundus, the latter the greater facilities for studying the condition of single points on the nerve or on the retinal surface. It is therefore necessary to be conversant with both, and to use one or both as circumstances may require.

*Indirect Method.*—In using the indirect method, the observer takes a biconvex lens, of about two inches focal length, and holds it with his free hand in the track of the returning light, and at about two inches from the eye of the patient. The rays of light, thus rendered convergent, become united into an aerial inverted image of the fundus of the eye, which image, and not the fundus itself, will be the object of vision to the observer. The position of the image is in the focal plane of the lens, nearer to the spectator; and, in order to see it clearly, nothing is necessary but to have the observing eye in the track of the returning rays, and at the right distance from the image; which, it must be remembered, with a two-inch lens, will be four inches or more nearer to the observer than the eye of the patient. The whole art of using the ophthalmoscope for the indirect method may be said to consist in moving the eye to and fro upon the line of sight until the right distance is attained, without moving it laterally so as to get out of the track of the rays, and without losing the illumination. As soon as a vessel, or any other defined object, is seen, the observer knows that his distance is correct, and he then causes the patient to change the direction of his eye until every part of its fundus has come successively into view. The image, it must be remembered, is inverted in every particular; its nasal side representing the temporal side of the retina, and its upper portion the lower portion of the retina. In first attempts to use the ophthalmoscope it is desirable to have the pupil of the observed eye dilated by atropin or duboisin, but, after dexterity has been attained, the dilatation may in most cases be omitted. The details of the retinal image are sometimes more or less obscured by an image or images of the lamp-flame; of which there may be two, one formed by the anterior and one by the posterior surface of the lens. These images are only sources of embarrassment when the lens is held vertically, and may be displaced and put out of sight by giving it a small degree of obliquity. A bright image of the mirror itself upon the retina, showing the central perforation as a dark spot, is sometimes troublesome to beginners; and it is said that this image has even been mistaken for that of the optic nerve. The blackness and sharp definition of the perforation should render such a mistake impossible; and the image may readily be displaced by a slight alteration of the angle at which the mirror is held.

In order to magnify the inverted image, and to increase its brightness by bringing the mirror nearer to the eye of the patient, a convex lens may be placed behind the mirror for the observer to look through. Something of this kind is always necessary for observers who have reached the period of life at which spectacles are required for reading; and it is advantageous to all persons. The writer's practice is to use a lens of about seven inches' focal length in this manner; and there is thus obtained an image which for many purposes is as good as that afforded by the direct method. With such a lens, the eye of the observer can be only seven inches from the image, and, as this will be formed four inches in front of the eye of the patient, it follows that the two faces will be only eleven inches apart. At this comparatively small distance, the illumination of the fundus of the observed eye, which is afforded by a good mirror, is exceedingly satisfactory.

*Direct Method.*—In the direct method, the observer does not apply any intervening glass between the mirror and the eye of the patient, but

comes as close to the latter as possible, and looks, not at an aerial optical image, but at the actual fundus itself, magnified by its own crystalline lens. It is only when the eyes of both observer and patient are of normal refraction, or emmetropic, that this can be done without the aid of a lens, which when required is most conveniently placed behind the mirror. The lens employed for this purpose must be such as to correct the sum of the error of refraction of both the eyes; and must therefore be concave when this error is on the side of myopia, convex when it is on the side of hypermetropia. An observer who is short-sighted will begin his investigation with a concave lens behind his mirror, which corrects his own short sight; and he will add to or diminish the power of this lens to meet any degree of ametropia which the observed eye may present in addition to, or in diminution of, his own. In order to facilitate the required changes, all necessary lenses are now usually mounted upon a revolving disc placed behind the mirror, and so arranged that each one of them can be brought in turn before the aperture. In one of the best of the modern forms of instrument, that of Dr. Loring, of New York, the mirror itself is made to turn upon pivots in a vertical line independently of the disc of lenses, so that the correcting lens receives no obliquity from the position of the mirror. This contrivance is valuable in some cases, especially when a correcting lens of high power is required, because such a lens, if held obliquely, is liable to produce some distortion of the objects seen through it. In using the revolving disc, a normal-sighted observer commences with no lens behind the aperture; and, if he then obtains clear definition, he knows that the eye into which he is looking is normal-sighted also, or at most is only in a slight degree hypermetropic. If, on the contrary, he does not obtain a clear image, he knows that the eye into which he is looking, unless the transparency of its media be impaired, is not normal-sighted, but that it is either myopic, or hypermetropic in a somewhat high degree. Keeping the fundus in view, he causes the disc to revolve, until a lens comes over the aperture which renders the picture distinct; and he has then only to see the number and kind of the lens in order to know the degree as well as the nature of the defect of refraction. In many cases it is even possible to prescribe spectacles, as the result of such an examination, with a very fair degree of correctness and success. But the chief use of the direct method, especially in the applications of the ophthalmoscope as an instrument of diagnosis in general medicine, is to scrutinise, as already stated, some portion of the fundus of the eye which has been shown, by the indirect method, to require more minute examination than that method will itself permit the observer to accomplish.

Opthalmoscopic Appearances.—In order to interpret ophthalmoscopic appearances, and to distinguish physiological variations from pathological changes, it is before all things necessary to bear in mind the anatomy of the structures which are, or may be, rendered visible, and the relations which they bear to one another. The fundus of the eye is composed of several layers, the more anterior of which commonly conceal the posterior; and conceal them in such a manner that, when the former are rendered more transparent by malformation or disease, the latter are brought into view.

1. *Sclerotic.*—Commencing with the posterior layer, it consists of the inner surface of the sclerotic, a smooth and shining white surface, which is ordinarily entirely concealed by the pigmentation of the choroid and of the posterior or epithelial layer of the retina. The sclerotic is naturally visible, as a general white background to a vascular network, in cases of albinism, in which the natural pigment of the eye is congenitally absent; or in some very fair persons, who are not albinos, but whose eyes are very sparingly pigmented. It is rendered visible in patches, as a result of malformation or disease, in cases in which it is exposed by a fissure through the choroid, such as generally accompanies *coloboma iridis*; in cases in which the choroid has suffered atrophy as a result of antecedent hæmorrhage or inflammation; and in the immediate neighbourhood of the optic discs, in the so-called crescents of choroidal atrophy which are so often associated with high degrees of myopia. The whiteness of an exposed sclerotic may be distinguished from that of an opaque white deposit in the choroid or in the retina, by many small physical characters, such as the relation of the borders of the whiteness to the neighbouring tissues and vessels, which will show the one to be the result of the removal, the other of the addition, of material. The most conspicuous white deposits are those associated with albuminuria or diabetes, with syphilitic retinitis, and with the first stages of retinal glioma. In all these the deposits manifestly cover and conceal vessels, which may be seen to emerge from beneath them; while in complete atrophy of portions of the choroid, it is not uncommon to see a few remains of dwindled vessels, and other shreds of choroidal tissue, rendered unusually conspicuous by their white background, and manifestly situated in a plane anterior to it.

2. *Choroid.*—The next layer from behind forwards is the choroid, which is essentially a vascular network, containing more or less pigment in the intervals between the vessels. In very fair eyes, as already mentioned, the choroid may allow the general whiteness of the sclerotic to shine through; but, in the great majority of cases, it conceals the latter entirely. In like manner, the actual structure of the choroid is itself usually concealed by the pigment in the epithelial layer of the retina; and the choroid generally only plays the part of a red background, varying up to dark chocolate colour in very dark eyes, and exhibiting neither structure nor vessels. When the retinal epithelium is scantily pigmented, as occurs in light eyes, the larger choroidal vessels may be seen through the retina; and they are readily distinguished from those proper to this structure by their different arrangement; the vessels of the retina being arborescent, whilst those of the choroid are either nearly parallel to one another, or arranged in more or less diamond-shaped reticulations. When both sets are visible together, moreover, the vessels of the retina will be clearly seen to be in a plane anterior to that of the vessels of the choroid, and a variety of minute

differences of colour and aspect will suffice to show that the two sets form parts of different circulatory systems.

3. *Retina.* — The retina itself is formed of several layers, the deepest of which contains the perceptive elements, or the rods and cones of the so-called Jacob's membrane. In front of the perceptive elements there are ganglionic and granular layers, subservient to the functions or to the nutrition of the rods and cones; and, in front of these again, a layer of connective-tissue, containing and supporting the conducting fibres which are ultimately massed together in the trunk of the optic nerve, and which convey impressions from the retina to the brain. The fibre layer and its connective tissue are necessarily thickest in the immediate neighbourhood of the optic nerve, and they thin off towards the peripheral parts of the retina; whilst all but the perceptive elements are wholly wanting over a small circle or depression at the posterior axis of the eyeball, a little to the outer side of the nerve, and known as the 'yellow spot,' with its *fovea centralis*. The central artery of the retina enters the eye in the trunk of the optic nerve, and the central vein emerges in the same manner, the circulation between the two being almost a closed one, save for a few very small and insignificant anastomoses of the terminal vessels, some at the nerve-entrance itself, others in the ciliary region. The retinal blood-vessels are chiefly lodged in the connective tissue of the fibre layer, and only small twigs dip down into the deeper retinal tissues. The arteries and arterioles divide, and the veinlets and veins unite, in an arborescent fashion; and the two sets of vessels are readily distinguished apart by the larger calibre and deeper colour of those which carry venous blood. At the nerve-entrance, both sets bend at a right angle or nearly so, in order to pass from the axis of the nerve-trunk into the plane of the retina, or *vice versâ*.

Between the rods and cones of Jacob's membrane, and the anterior or capillary layer of the choroid, there is a sheet of pavement-epithelium, the cells of which contain a larger or smaller quantity of pigment. This epithelial layer was at one time regarded as part of the choroid, but more recent histologists refer it to the retina. When full of pigment, it forms an opaque screen, by which the choroid is concealed from view, and against which the delicate retinal structures, especially near the nerve, may become apparent as a thin, almost pellucid, film, in which blood-vessels ramify. In the eyes of fair people, with only scanty pigmentation, the epithelium neither completely conceals the choroid, nor does it throw up the retina with anything like the same distinctness, so that the retinal blood-vessels are clearly seen, but not the structure which supports them. When the pavement-epithelium has been removed, either by disease or by senile changes, the choroidal tissues become conspicuous.

4. *Optic Nerve.*—The general aspect of the optic nerve varies greatly, within limits defined by differences in the degree of its capillary vascularity, by the effects of contrast arising from the degree of pigmentation of the surrounding parts, and by the mechanical arrangement of the structures of which it is composed. The aperture in the sclerotic, by which the nerve enters the eye, is closed by a cribriform plate of condensed connective tissue, the *lamina cribrosa*; and the fibres normally leave their sheaths on the outer side of this lamina, only the axis-cylinders passing through its perforations. The combined axis-cylinders constitute a mass the whiteness of which is subdued rather than glistening, and which derives a certain amount of reddish, roseate, or pink colour from the capillary vessels by which it is permeated. The axis-cylinders, like the vessels, bend round as they pass from their original direction into that of the retinal surface; and, in the majority of instances, they leave a central depression in the nerve-disc as they separate, a depression at the bottom of which the glistening whiteness of the lamina cribrosa is visible, and which has been called the *porus opticus*. In other instances, this central depression does not exist, but the axis cylinders are gathered chiefly towards one side of the nerve-entrance, and the lamina is visible laterally instead of centrally. The size of the *porus opticus* is very variable, insomuch that sometimes, when it constitutes quite a large central depression, it is described as congenital or physiological excavation of the nerve. This congenital excavation is always readily distinguishable from the excavation produced by the pressure consequent upon excess of internal tension; because the former never, and the latter always, extends to the extreme margin of the nerve. In other words, the congenital excavation, however large and remarkable, is always surrounded by a ring of nerve-tissue; while the morbid excavation always extends to the margin of the opening in the sclerotic. The position of the blood-vessels in the nerve-entrance is also another variable factor, since they are sometimes nearly central, and at others are seen to pass into or out of the nerve-tissue close to its margin. In a few cases, moreover, the axis-cylinders at some portion or portions of the circumference carry their sheaths for a short distance into the retina; and the nerve is then surrounded by white glistening processes, with brush-like terminations. Sometimes, again, the margin of the opening in the choroid is richly pigmented, and the nerve is surrounded with a ring, or bordered by a crescent, of chocolate or black colour.

5. *Fundus as a Whole.*—The general appearance of the healthy fundus oculi may be summed up somewhat in the following way: the background seen in the inverted image ranges in colour from an almost chocolate tint in very dark people or in the dark races, to a closely woven reticulation of vessels carrying red blood, and affording indications of the white sclerotic lying behind them. In light eyes, the retina itself is invisible; but in dark eyes its thickest portion appears as a delicate film, which has been compared to moistened tissue-paper, over the portion of the field which immediately surrounds the optic nerve. Except in very light eyes, the vessels of the choroid are not individually visible, being concealed by the pigmentation of the pavement-epithelium; and, when visible, they are distinguishable by their parallel direction, and by the absence of branches. The vessels

of the retina are always clearly visible, and may be traced along their numerous arborescent ramifications to twigs of extreme fineness. The arteries are smaller and brighter than the veins, and often present the appearance of a white line running along the axis of the vessel, almost as if it were a translucent red tube, carrying a white fluid. The veins, larger and darker than the arteries, seldom display the white line. The vessels pass off the optic disc on all sides, but make bold curves which carry them clear of the region of the yellow spot. In the close vicinity of the disc, the vessels are sometimes attended by fine white threads, pursuing the same general course with them, and which are apparently coarser portions of the connective tissue by which they are sustained. The optic disc, or termination of the optic nerve itself, the most conspicuous object in the ophthalmoscopic image, stands out boldly against its surroundings, and presents a general colour-effect which depends partly upon the richness of its capillary blood-supply, and partly upon the greater or less degree of pigmentation of the tissues around it. Over part of its surface, generally in or near the centre, but sometimes laterally, it displays the whiter colour of the lamina cribrosa, and the mottling of its perforations for the passage of the nerve-fibres. It is often bordered, either entirely or partially, by a line of dark pigment situated at the margin of the choroidal opening; and it often exhibits also a fine white line at its margin, which is the edge of the opening in the sclerotic, seen through the semi-transparent nerve-tissue. The vessels pass over its margin without deviation or change of plane. The apparent size and shape of the disc depend much upon the refraction of the eye. As seen in the inverted image, it appears comparatively small in a myopic eye, and large in a hypermetropic; while, in cases of astigmatism, it is distorted into the appearance of an oval. In the same way, the refraction modifies the apparent actual, but not the relative calibre of the vessels. In the myopic eye the vessels appear of small diameter, and in the hypermetropic they appear of large diameter; so that no conclusions about their actual size can be drawn until the state of refraction has been taken into account. The fact that the veins are relatively larger or smaller than usual, when compared with the arteries, is, of course, not influenced by refraction, except that, in a hypermetropic eye, such a difference would be more conspicuous than in a myopic, by reason of the more magnified image produced by the optical conditions of the media.

6. *Circulation.*—In a general way, the blood-currents in the vessels of the retina are continuous and uninterrupted; but any hindrance to the entrance of blood may be attended by pulsation, first in the veins and subsequently in the arteries. Such hindrance may arise from disordered action of the heart, as in cases of insufficiency of the aortic valves; from disease of the coats of the arteries; or from increased resistance on the part of the fluids already occupying the cavity of the eyeball. The venous pulse depends upon an arrest of the outflow through the veins by the pressure of the entering arterial current; which, at the acme of the pulse-wave, has force enough to push back the venous current when there is not room enough for both. Hence, in the venous pulse, the vessels empty themselves in a direction from the centre of the disc towards its periphery, and refill in the opposite direction. The ordinary cause of venous pulse is increased tension or fulness within the eyeball, so that it is among the early symptoms of glaucoma; but it is also to be seen in a small proportion of cases in which no excess of tension is to be discovered either by touch or by symptoms, and in which the eyes appear to be healthy. In the arterial pulse, the resistance to the entrance of blood, or rather the disturbance of the balance between the propulsive and the resisting forces, must be considerable; and the course of events is that the arterial current can only make its way into the eye at the acme of the pulse-wave, during which the arteries fill from the periphery of the disc to the centre, to collapse again as soon as the impulse of the systole diminishes. In such a condition, the impediment to the entrance of arterial blood is sufficient to imperil the nutrition of the nerve-tissue; and the writer has seen at least one case of partial nerve-atrophy, attended with arterial pulsation, for which no other cause than excessive arterial tension could be assigned. Arterial pulse is probably always present in advanced stages of glaucoma, but by the time it is produced the fundus is usually obscured or rendered invisible by other changes. Apart from glaucoma, its most frequent cause is aortic regurgitation; and in this form the eye does not suffer, except together with other parts of the organism.

7. *Optic Neuritis and Atrophy.*—The morbid appearances seen with the ophthalmoscope, and interesting to the physician, are chiefly those which point to the existence of some diathesis, or to the presence of disease in other organs. Swelling of the intra-ocular extremity of the optic nerve, with obliteration of its margins and obstruction to its vessels, occurs in many forms of intracranial disease, especially in connection with intracranial tumour, and is often followed by atrophy and blindness when life is sufficiently prolonged. The most interesting characteristic of these cases is that, since the swelling affects only the connective-tissue layer, which is absent over the region of the yellow spot, there is commonly no diminution of the acuteness of central vision until the atrophic changes have commenced; by which time, in many instances, the primary swelling has passed away. Hence, for many years, there existed great uncertainty about the cause of the atrophy, and this uncertainty was only removed when physicians began to examine the fundus oculi in all cerebral cases, without regard to the state of sight. Prior to that time, the intra-ocular changes were apt to remain undiscovered in their primary stage, and until commencing impairment of vision produced resort to an ophthalmologist, followed by an ophthalmoscopic examination in due course; and then the atrophy was often attributed to many fanciful causes, among which the smoking of tobacco held a prominent place. It is not necessary to assume that tobacco is never injurious to the optic nerves, in order to be quite sure that the majority of the instances of atrophy once attributed

to its influence were, in reality, due to a totally different cause. The changes associated with intracranial diseases will be found described in a special article. *See* OPHTHALMOSCOPE IN MEDICINE.

8. '*Albuminuric Retinitis.*'—Very frequently in albuminuria, and occasionally in diabetes mellitus, the fundus of the eye becomes studded over with spots or patches of a glistening white colour, which are probably due to fatty degeneration of the connective tissue of the retina, and which are often associated with scattered hæmorrhages. The blood, in these instances, is usually effused into the fibre-layer, and, following the course of the fibres, becomes spread out into somewhat striated spots, with brush-like terminations. Every case in which either the white patches or the hæmorrhages, or both, are detected by the ophthalmoscope, whether with or without impairment of sight, calls for a careful examination of the urine, and renders it proper to follow mainly the indications of treatment which such an examination may afford.

9. *Hæmorrhages.*—Without the white patches, hæmorrhages may occur in the retina under various conditions. Sometimes they are distinctly arterial, in which case they are generally small in absolute amount, and may often be traced to some manifest point of rupture in the vessel from which they have occurred. These hæmorrhages seldom produce extreme impairment of vision, although they are usually discovered on account of some degree of impairment; and their chief importance is derived from the warning they may give of a state of brittleness of the arteries, and of a consequent liability to similar bleedings elsewhere, as in the brain. They call for all the precautions which such a state would suggest, as for the consumption of a diminished quantity of fluid, and for the avoidance of constipation and of all violent bodily efforts.

Hæmorrhages which are distinctly venous occur not unfrequently in connection with the disturbances of circulation which are incidental to the cessation of the menstrual function, or to the irregularities by which cessation is preceded. The blood may proceed from comparatively large veins, in which case it often forms a layer immediately beneath the *membrana limitans* of the retina, causing great temporary impairment of sight, or even total blindness; and yet, in many cases, being quickly absorbed without permanent injury. In other instances it may proceed from smaller and deeper-lying veinlets, in which case the effusion will usually be situated in the fibre-layer, and will be moulded, so to speak, by the fibres, into what have been described as 'flame-shaped' hæmorrhages. These are generally multiple, and usually cause an impairment of function, which is decided although not total, and is often permanent. The flame-shaped hæmorrhages are said by Mr. Hutchinson to occur preferably in persons of gouty diathesis, and he holds the same doctrine with regard to a less common form, of which some remarkable examples have been observed by himself, and by Mr. Eales of Birmingham. In these cases, the subjects were young males, of constipated habit, and in many instances of gouty family history. The bleedings were large in amount so as to penetrate into the vitreous body and to cause for a time total loss of sight, and were frequently recurrent. To what extent they were due to deficient plasticity of the blood, to abnormal friability of the vessels, to variations in vaso-motor tension, or to the withdrawal of external support from the vessels by diminished tension within the eyeball itself, is at present a matter of conjecture. It is obvious that the treatment of such cases, and of retinal hæmorrhages generally, must resolve itself into that of the constitutional conditions with which they are associated. The only special indications, as regards the eye, will be the enforcement of functional rest, and the maintenance of an elevated position of the head during sleep. In cases connected with the cessation of the menstrual function, the absorption of the effused blood often appears to be promoted by the careful administration of iodide of potassium, which should usually be combined with ammonio-citrate of iron, or with some other suitable tonic, and care should always be taken to maintain a moderately relaxed condition of the bowels. Even apart from the injurious effects likely to be produced by straining, constipation appears to predispose to hæmorrhage.

10. *Embolism of the Central Artery.*—Sudden loss of vision is sometimes occasioned by the plugging of the central retinal artery by an embolus. This is especially to be suspected in cases of known valvular disease of the heart, and the condition is readily recognisable with the ophthalmoscope. The retinal veins are usually somewhat dilated, but their contained blood is broken up into irregular portions, in which an uncertain or wavering movement may sometimes be detected. The arteries are either obliterated, or so dwindled as to be scarcely visible. The connective tissue of the retina rapidly becomes cloudy and opaque, so that the general surface of the fundus is milky or opalescent; but in the region of the yellow spot, where there is little or no connective tissue, this opacity cannot be produced, and the red colour of the choroid shines through, producing the effect of a cherry-red spot on a white ground. After a few weeks the retina regains its transparency, but the optic nerve passes into a state of absolute atrophy.

R. BRUDENELL CARTER.

## OPHTHALMOSCOPE IN MEDICINE.

In a large number of diseases which come under the care of the physician—diseases of the nervous system, kidneys, blood, and other structures—intra-ocular changes occur, and may be observed with the ophthalmoscope. Hence this instrument is highly useful to the physician. By its aid we can observe, magnified about twenty diameters, the termination of an artery, of a vein, and of a nerve; a peculiar vascular structure (the choroid); and a peculiar nervous structure (the retina). Nowhere else are nerve and vessels exposed to direct observation. Many changes affecting these tissues throughout the body may be first and best detected here, and in some other diseases these intra-ocular structures are affected in a special manner.

The chief changes in the fundus oculi which are of importance to the physician are the following:—(*a*) In the *retinal vessels*:—variations in

size, in the condition of their walls, the existence of aneurisms, the tint of the blood, the occurrence of visible pulsation in arteries or veins, of hæmorrhages, or of vascular obstruction. (*b*) In the *optic nerve* or *papilla*:—congestion, neuritis or papillitis; atrophy, simple, consecutive (after neuritis) or choroiditic. (*c*) In the *retina*:—various inflammatory or degenerative changes or growths. (*d*) In the *choroid*:—inflammatory exudations, with their resulting disturbance of the choroidal pigment, atrophy, growths. For a description of these various changes the reader is referred to the special articles. In this place it is only possible to point out the changes which present themselves in the various special diseases which come under the physician's care.

I. Diseases affecting the Nervous System. 1.—Brain.—Two forms of ocular changes are met with: (1) 'associated,' the consequence of the cause of the cerebral disease; (2) 'consecutive,' the direct result of the cerebral disease. *Anæmia* and *hyperæmia* of the brain are not, as a rule, revealed by any corresponding change in the retinal circulation, this being regulated in a special manner by the intra-ocular tension. Such changes, when affecting the whole head and considerable in degree, are, however, shared by the retinal vessels. Moreover, acute cerebral hyperæmia may, after a time, lead to congestion of the optic papilla. *Acute general cerebritis* is usually accompanied by meningitis, and to the latter the ophthalmoscopic changes are probably in part due. There is a form of *chronic cerebritis* or *encephalitis*, of which the symptoms are somewhat like those of tumour, but the only changes to be found after death are microscopic. In this condition well-marked neuritis (papillitis) may be present.

In *cerebral hæmorrhage* consecutive changes are extremely rare, and are almost confined to cases of meningeal hæmorrhage, from which slight neuritis may result. Of associated changes, aneurisms are rare, but have been noted; retinal hæmorrhages are not unfrequent. They are most significant in blood-states, although most common in renal disease associated with albuminuric retinitis. In the latter they indicate vascular disease, but not necessarily that a cerebral lesion is hæmorrhagic, since they are often associated with softening of the brain.

In *softening from embolism*, retinal embolism may be, in rare cases, associated. In ulcerative endocarditis septic hæmorrhages may be seen in the retina. Consecutive changes are, as a rule, absent; occasionally slight optic neuritis is developed.

In *softening from arterial thrombosis*, when this is due to atheroma of the vessels, associated changes (hæmorrhages, or renal retinitis) may be found in the retina, but there are usually no consecutive changes. The latter are also absent in thrombosis from syphilitic disease of arteries; but associated changes—the various ophthalmoscopic manifestations of syphilis—are common, and are often of the highest diagnostic importance.

In *abscess of the brain*, optic neuritis occurs in a considerable number of cases, although not in all. It has no known relation to the position of the abscess, but is perhaps most frequent in the cases in which the abscess results from an injury.

*Tumours of the brain.*—Associated changes are very rare, and are confined to the cases in which a similar growth (glioma or tubercle) exists within the eye. Consecutive changes are more common than in any other cerebral affection. Optic neuritis occurs in about four-fifths of the cases. On what its occurrence or absence depends we do not know. Neither position, size, nor nature of growth seems to influence it in any considerable degree. It does not depend on increase of intracranial pressure. In some cases it is at least aided by the occurrence of meningitis. In many cases a slight descending inflammation may be traced from the optic tracts down the nerves to the eyes, and this, at the papilla, seems to excite a more intense degree, perhaps aided by mechanical congestion or œdema of the sheath. The latter is commonly found after death, but probably does not constitute the chief mechanism by which neuritis is produced. A tumour may exist for a long time without neuritis, or the neuritis may be present as soon as the symptoms of tumour manifest themselves. Often the neuritis and the tumour correspond in their course, each being acute or chronic. Both may even be almost stationary for years. An acute neuritis, occurring during the course of a tumour which appeared chronic, usually indicates an increase in the growth, and is of bad prognostic significance. The degree of neuritis varies; it is least in the tumours of most chronic course, and greatest in the rapid growths. It is often accompanied by hæmorrhages. Commonly bilateral, it is in rare cases unilateral, and is then usually in the eye opposite to the seat of the tumour. It may exist in considerable degree without impairing sight. Perception of colour may be affected before acuity of vision. If the tumour be arrested by treatment, as in syphilitic and tubercular growths, the neuritis will subside, but too often, before this result is obtained, sight has been damaged beyond recovery. Simple atrophy of the optic nerves sometimes results from tumours, although far less commonly than 'consecutive atrophy.'

*Intra-cranial aneurisms* are rarely accompanied by intra-ocular changes. Now and then, an aneurism of the internal carotid has caused atrophy by pressure, and even optic neuritis, single or double.

*Internal hydrocephalus* is usually accompanied by no other ophthalmoscopic changes than slight fulness of the veins. Occasionally simple atrophy occurs, commonly from the pressure of the distended third ventricle on the optic chiasma.

*Meninges.*—Growths in the meninges lead to optic neuritis, just as do tumours in the cerebral substance. The effect of meningitis varies according to its form and seat. Simple meningitis of the convexity is rarely attended by ocular changes. It is very different with basilar tubercular meningitis. Occasionally, though rarely, tubercles of the choroid may be seen. In a considerable number of cases there is distinct neuritis; it is well-marked in at least half. Usually too late to be of diagnostic importance, it is now and then sufficiently early to decide the

nature of the case. A similar change is common in both syphilitic and traumatic meningitis, but is very rare in the epidemic cerebro-spinal form.

*Diseases of the cranial bones.*—Caries of the sphenoid bone may cause descending neuritis; caries elsewhere usually only affects the eye by causing meningitis or abscess. Thickening of the cranial bones may be attended by well-marked, sometimes intense, neuritis, with hæmorrhages. This is apparently produced by the resulting constriction of the nerve and sheath at the optic foramen. Inflammatory mischief, or growths in the orbit, frequently cause neuritis or atrophy, the optic nerve-trunk being damaged directly. In these cases the affection is unilateral, at least for a long time, and is often accompanied by prominence of the eyeball, and tenderness when it is pushed back.

*Injuries to the head* may affect the eye in various ways. (1) The retina may suffer in consequence of the immediate concussion. (2) Optic neuritis may come on after a few days, commonly as the result of a traumatic meningitis. (3) Direct injury to the optic nerves may cause loss of sight and simple atrophy. (4) Optic neuritis may come on some weeks after the injury, and is usually due to inflammatory processes in the damaged brain.

2. **Spinal cord.**—*Acute myelitis* and *spinal meningitis* are very rarely attended by eye-changes. In one or two cases coincident optic neuritis has been observed. The connection between the two is obscure. *Sclerosis of the posterior columns* (locomotor ataxy) is accompanied by atrophy of the optic nerves in a considerable number of cases, although not perhaps in more than fifteen per cent. When it does occur it is frequently an early rather than a late symptom. It is always the simple form of atrophy, often grey with unnarrowed vessels. Sight usually suffers gravely; the field of vision is much restricted; and perception of colours may be lost. The atrophy is not the result of any extension upwards of the disease in the posterior columns. It may occur when this has scarcely commenced, and even years before the earliest symptoms. It is apparently an associated degeneration. In *lateral sclerosis* ocular changes are doubtful. In *disseminated sclerosis*, optic nerve-atrophy may occur, just as in posterior sclerosis, but less frequently. Damage to sight, without opthalmoscopic changes, occasionally results from the sclerosis invading the optic commissure or nerves. In caries of the spine changes in the optic disc are practically unknown. In very rare cases of injury to the spine, neuritis and subsequent atrophy have been observed, but these results are so rare that their precise significance is doubtful.

3. **Functional Diseases.**—In *exophthalmic goître* the only ophthalmoscopic change is increased size of the retinal arteries, which may pulsate visibly. In *chorea*, embolism of the central artery of the retina has been once or twice observed; and so also has optic neuritis, slight in degree. As a rule, however, the fundus is normal. With *neuralgia* of the fifth, optic nerve atrophy has been observed; the nature of the association is doubtful. In *idiopathic epilepsy* the appearance of the fundus is, as a rule, perfectly normal. Even during an attack it is probable that the only change is venous distension during the stage of cyanosis. But during the status epilepticus, when attacks recur with great severity for several days, a condition of slight neuritis may be produced, subsiding after the attacks are over. In cases of *convulsions* from organic brain-disease, it must be remembered, optic neuritis or its effects are often met with. The frequency with which morbid appearances are to be seen in the eye in *insanity* has been variously stated, and by some writers unquestionably exaggerated. They are most frequent in general paralysis of the insane. Optic-nerve atrophy is the usual change, and is sometimes an early event, just as in locomotor ataxy. In very rare cases slight neuritis has been seen. In mania, melancholia, and dementia it is probable that there are no related morbid appearances in the eye.

II. Diseases affecting the Urinary System:—

1. **Bright's Disease.**—Sight may be impaired in this complaint by uræmic poisoning, or by retinal changes. The latter may occur, even in considerable degree, without any affection of vision. The arteries may occasionally be conspicuously narrow (contracted), and in rare cases may present sclerosis of the outer coat, or minute aneurisms. Aneurismal dilatations of the capillaries may often be found *post mortem*, in association with other degenerations, and probably lead to the occurrence of a very common change in the retina—hæmorrhages. These are usually striated, situated in the nerve-fibre layer; sometimes they are irregular in shape, and situated in the deeper layers. They may detach the retina from the choroid, or burst through into the vitreous. Sometimes they exist alone; more commonly they are conjoined with other changes, to which the term 'albuminuric retinitis' is given. This latter change may occur in all forms of renal disease, but is by far the most common in the granular kidney. It is a late symptom, never appearing until the general system is suffering. The disease of the retina presents certain elements which are variously combined in different cases. 1. Diffuse slight opacity and swelling of the retina, due to the infiltration of its substance by an albuminous coagulable liquid (œdema). 2. White spots and patches of various size and distribution; some large and soft-edged; others minute, and of pearly whiteness. They are due to fatty degeneration of the retinal elements, or to granular degeneration of albuminous exudations. The small white spots often radiate around the macula lutea. 3. Hæmorrhages. 4. Inflammation of the optic papilla—'neuritis.' 5. The subsidence of the inflammatory changes may be attended with the signs of atrophy of the optic nerve and retina. According to the predominant character, four types of retinal affection may be distinguished: a degenerative, hæmorrhagic, inflammatory, and neuritic form. In the first the white spots predominate, and there are usually extravasations, but there is little diffuse opacity. In the second the hæmorrhages are so abundant as to be the chief feature. In the third there is much diffuse opacity and swelling of the retina. In the fourth the optic neuritis is in excess of the other

changes, and the appearance may easily be ascribed to cerebral disease—the more so that it is often conjoined with headache, and other evidence of cerebral disorder. The conspicuous combination of white spots and hæmorrhages usually enables the retinal affection of albuminuria to be recognised without difficulty. It may be confounded with the degeneration left by a previous wide neuro-retinitis, but in such cases the signs of atrophy will be conspicuous. The course of the affection in Bright's disease is often progressive, but arrest and even recovery may be obtained by the treatment of the renal disease. When extensive, sight is usually impaired, but is rarely completely lost.

2. **Diabetes.**—In diabetes, in rare cases, retinal changes have been observed exactly similar to those of the degenerative form of the albuminuric affection, and this when there was no albumen in the urine. Miliary aneurisms have been found *post mortem*. A distinction from the renal form is the frequency with which there are opacities in the vitreous, due probably to slight extravasations of blood.

III. Diseases of the Heart.—The peculiar conditions of the intra-ocular circulation prevent any dynamical changes in the circulation. Venous distension, if considerable, may be visible in the eye, especially in cyanosis. When arterial pulsation is strong it may be visible in the retinal arteries, as in exophthalmic goître and in aortic regurgitation. In these cases also the arterial pulsation may (probably in the sclerotic ring) be communicated to the vein, and this also may pulsate. Embolism of the central artery of the retina may occur, and, like embolism elsewhere, is most common in mitral constriction. In ulcerative endocarditis, accompanied with multiple embolism, retinal hæmorrhages occur, for the most part round, with a pale or white centre. They are almost pathognomonic.

IV. Diseases of the Blood.—Acute *anæmia* from hæmorrhage may be followed by loss of sight, slight or considerable, transient or permanent. The accident most commonly follows hæmatemesis, uterine hæmorrhage, or venesection. In some cases no ophthalmoscopic changes have been found; in others there has been neuro-retinitis. The mechanism of the affection is obscure. Simple chronic anæmia is accompanied by marked pallor of the veins, sometimes of the choroid and disc, but the latter is always within the physiological variations in tint. Occasionally in chlorosis optic neuritis is met with, disappearing rapidly under iron. In *pernicious anæmia* the choroid is notably pale, the arteries small, the veins very broad (atonic) and pale. Hæmorrhages are frequent, especially around the optic disc, and they are often associated with white patches. Some extravasations are rounded, with a white or pale centre. Occasionally there is marked neuritis. In *leucocythæmia* the pallor and width of the veins are very striking. Extravasations are almost invariable at some period: white spots are frequent, some degenerative, others due to aggregations of leucocytes. Some are surrounded by a halo of extravasation. There may also be considerable general swelling of the retina, throwing the distended veins into conspicuous antero-posterior curves. In *purpura* and *scurvy* retinal hæmorrhages also occur. In the intense forms of purpura, indeed, they are probably constant.

In rare cases of *menstrual* disorders, and still rarer instances of *intestinal* disturbance (chronic diarrhœa) optic neuritis has been observed. Suppression of the menses has been followed by retinal hæmorrhages. The connection between the several events is obscure.

V. Chronic General Diseases.—In chronic general diseases ophthalmoscopic changes are met with occasionally. In *tuberculosis*, tubercles may form in the choroid, and be recognisable as small, round, yellowish-white spots, free from pigment. They have more frequently been found in this situation after death than during life, perhaps because not looked for with sufficient perseverance, since they may form rapidly. In *syphilis* ocular changes are, as is well known, common, but they come chiefly under the care of the surgeon. Traces of past iritis, or of choroiditis—areas of choroidal atrophy with irregular accumulation of pigment, frequently afford the physician important evidence of the previous existence of syphilis, acquired or inherited. In the latter the choroidal changes are of especial importance, and may be confined to small round white spots with pigment in the centre, or there may be evidence of more extensive choroiditis or merely of choroiditic atrophy, a yellowish disc, with the edge a little blurred, and very small retinal vessels. *Gout* has been supposed to cause retinal hæmorrhage (Hutchinson), but its connection with ophthalmoscopic change (except through the medium of kidney-disease) is not well-established.

In *lead-poisoning*, besides the amblyopia which may come on without ophthalmoscopic changes, atrophy of the disc is occasionally met with, preceded, in some cases, by a stage of congestion, a red disc, with softened edges, without swelling. A considerable degree of neuritis, double, with swelling and hæmorrhages, occurs occasionally, especially in connection with cerebral symptoms, but without any coarse lesion of the brain. In *chronic alcoholism*, optic-nerve atrophy has been described, and also a condition of congestion. The amblyopia which accompanies the atrophy is said by Förster to be characterised by loss of central vision for colour. The same fact is well established with regard to *tobacco* amaurosis, in which similar congestion and atrophy may occur.

VI. Acute General Diseases.—In acute general diseases, changes in the fundus are for the most part rare. After *typhus*, *typhoid*, and *scarlet fevers*, optic neuritis has been occasionally observed, apart from any renal or cerebral complication. The kidney sequelæ of scarlet fever may of course lead to the special retinal changes. *Malarial fevers*, *ague*, &c., are frequently attended with retinal hæmorrhages (Poncet, S. Mackenzie). Sometimes the extravasations have paler centres. Optic neuritis and atrophy have also been observed. *Erysipelas of the face* has been accompanied by loss of sight, and followed by atrophy, probably by the extension of the inflammation to the orbit, and to the trunk of the optic nerve. *Pyæmia* and *septicæmia* have long been known to be occasionally accompanied by metastatic panophthalmitis, and recent observation has shown

that slighter alterations in the fundus oculi frequently accompany the severer forms of these affections. Of these the most important are retinal hæmorrhages, round or irregular, sometimes large, and often with pale centres. It is probable that they are in some cases due to septic embolism, but they may occur without endocarditis, and are probably due, in some cases, to chemical changes in the blood. They are almost invariable in puerperal septicæmia (Litten), and are also found in other forms of ulcerative endocarditis. Usually, they occur only a few days before death. In other cases a peculiar form of retinitis has been observed, with white spots about the papilla and macula lutea (Roth).

Most of the appearances mentioned above will be found figured in the writer's *Manual and Atlas of Medical Ophthalmoscopy.*

W. R. Gowers.

**OPISTHOTONOS** (ὄπισθεν, backwards, and τόνος, a stretching).—A tetanic spasm, in which the body is arched backwards, so that it rests on the head and heels. *See* Tetanus.

**OPIUM, Poisoning by.**—In consequence of the extent to which opium and its preparations, including morphia, are used for the relief of pain, and the readiness with which the drug is procurable, poisoning by opium is of frequent occurrence; and there is no doubt that great numbers of infants perish every year in this country through the improper use of quack remedies containing opium.

So far as toxicology is concerned, the effects of opium may be referred exclusively to morphia; since the effects of the other active constituents of the drug are overshadowed by those of the chief alkaloid.

Anatomical Characters.—The *post-mortem* appearances after opium-poisoning may be almost *nil.* As a rule the brain is congested, the *puncta cruenta* being especially marked; and the lungs and right side of the heart may exhibit an engorgement, as if from a modified asphyxia; but this condition is by no means invariable.

Symptoms.—The first effect of the administration of a toxic dose of opium—a state of *bien-faisance* or exaltation—commonly observed also after the administration of a medicinal dose, may be either very short or entirely wanting; and this is commonly the case when morphia is injected hypodermically. A second stage, in which the symptoms closely resemble those of congestion of the brain, soon sets in. The face is either suffused or cyanosed; the pupils strongly contracted; the skin dry and warm; the breathing slow, deep, and becoming stertorous. The patient is apparently unconscious, but may be aroused by shaking, or shouting in the ear; and when he is aroused, the respirations become more rapid, and the skin may regain its normal colour. The symptoms of this second stage may gradually ameliorate under appropriate treatment; or a third stage—that of prostration—supervenes. The coma is now profound, and it may be impossible to arouse the patient. The pupils are contracted to the size of pin-points; or towards the termination of life may be widely dilated. Respiration is now very slow, shallow, with gradually increasing intervals, during which there are no signs of breathing, and the patient lies in a death-like calm. The face is at once pallid and cyanosed; the skin is bathed in perspiration, at first warm, and then cold and clammy. The pulse increases in rapidity, with progressively increasing feebleness. The patient may even now recover, signs of life returning very gradually; or death may occur from failure of respiration, the other functions of life becoming also gradually extinguished.

Unusual symptoms in opium-poisoning are trismus and convulsions. In children toxic doses may produce very rapid effects, the second stage of the intoxication being wanting, and severe collapse and complete unconsciousness rapidly supervening.

Diagnosis.—The certain diagnosis of opium-poisoning is often a matter of great difficulty, as the symptoms may differ in no material respect from those exhibited in congestion of the brain, however produced, apoplexy, and uræmia. The case may also be confounded with profound alcoholic intoxication. It may also be difficult or impossible to diagnose from poisoning by chloral hydrate—a matter of less importance, since the treatment of the two cases would be similar. The differential diagnosis of opium-poisoning rests upon the equally and minutely contracted state of the pupils, a condition which is all but universal in the second stage of opium-poisoning; our ability to arouse the patient temporarily, the rousing being followed by more or less complete disappearance of the cyanosis of the countenance, and by increased rapidity of respiration; and the profuse warm or clammy perspiration. An examination of the urine for albumin, which may have to be drawn off by the catheter, should always be made; but it must be borne in mind that uræmia and opium-poisoning may be co-existent.

Prognosis.—This is at all times doubtful. There is great liability to relapse, even when the patient appears to be doing well.

Treatment.—First, evacuate the stomach by means of the stomach-pump, or failing this, by the use of emetics. These, however, act with difficulty in cases of opium-poisoning; and there is a special danger in the use of depressing emetics, as, for example, tartar emetic, on account of the possible retention by the stomach of a fatal dose of the emetic. Warm mustard and water, and carbonate of ammonia are the best emetics to administer. Secondly, the patient must be prevented lapsing into a state of somnolence by walking him about; alternate warm and cold applications to the chest; flicking the feet with a damp towel; shouting into the ear; and the application of the faradic current. These means will have the additional advantage of maintaining the flagging respiration, and restoring normal breathing. In the last resort artificial respiration must be freely employed. The absorption of the alkaloids of opium may be delayed by the free administration of solutions containing tannin, so as to render the alkaloids insoluble; and among the best media containing tannin are strong infusions of tea and coffee. The caffein which these infusions contain, itself also exerts a powerful remedial influence in this form of intoxication. Atropin, as a respiratory

stimulant, appears also to be serviceable as a direct antidote to morphia. It is best given by subcutaneous injection, in doses of $\frac{1}{40}$th grain. Alcoholic stimulants should be freely given.

THOMAS STEVENSON.

**OPPRESSION.**—A term applied to a sense of weight in any part of the body, but more frequently used in connexion with the chest. The expression is sometimes also employed in reference to a general feeling of the system being over-loaded or over-weighted, which is felt at the commencement of certain acute diseases.

**OPTIC NERVE and TRACT, Diseases of.**—The optic nerve may be damaged by various intra-ocular processes; but these, and also its primary atrophy, have been already described (*see* EYE AND ITS APPENDAGES, Diseases of; OPHTHALMOSCOPE; and OPHTHALMOSCOPE IN MEDICINE). In this article only those affections which are situated behind and independent of the eye will be described.

Passing from the orbit into the intracranial cavity by the optic foramina, into which they closely fit, the optic nerves are connected at the chiasma, where an approximate semi-decussation takes place. In spite of recent assertions of Besiadecki and others, the existence of the semi-decussation is quite beyond doubt. From the chiasma each optic tract, containing fibres from the corresponding halves of both retinæ, passes backwards, between the crus cerebri and the inner edge of the temporo-sphenoidal lobe, to the posterior portion of the optic thalamus, where it becomes connected with the corpora geniculata. Fibres pass thence in three directions, namely:—(*a*) to the posterior extremity (pulvinar) of the optic thalamus; (*b*) to the corpora quadrigemina, especially the anterior; and (*c*) to the convolutions (occipital lobe and angular gyrus). Experiments on monkeys (Ferrier) demonstrate that these convolutions are concerned in vision.

ÆTIOLOGY.—In the orbit the nerve may be damaged by inflammation; such as orbital cellulitis, arising by the extension of facial erysipelas, or produced by exposure to cold. The inflammation rarely invades the nerve, on account of the thickness of the sheath which invests it, but the nerve is damaged by the pressure of the inflammatory products. It may also be compressed by an aneurism of the ophthalmic artery or by orbital tumours; or may be itself the seat of morbid growths or of hæmorrhage. At the optic foramen the nerve may be compressed by a narrowing of the foramen, such as occurs in thickening of the cranial bones, an occasional consequence of syphilis, acquired and congenital. Within the skull, the nerve in front of the chiasma may be damaged by the extension of inflammation from the meninges. The optic commissure is occasionally involved in growths, and may be compressed by growths in, or great distension of, the third ventricle. The nerves in front of the chiasma, and the chiasma itself, are liable to be damaged by the pressure of aneurisms of adjacent arteries. The optic tracts may be involved in hæmorrhage into, or softening of, the crura cerebri; but the most frequent cause of their damage is a tumour arising at the base of the brain, or in the adjacent part of the temporo-sphenoidal lobe. The central connections of the optic nerves, the corpora geniculata, optic thalamus, white substance outside it, and convolutions, may be damaged by tumour, softening, or hæmorrhage. The corpora quadrigemina are rarely affected, so as to cause ocular symptoms, except by growths.

SYMPTOMS.—Damage to the optic nerve, between the optic commissure and the eye, is evidenced by affection of sight in that eye only. There may be either a concentric or sector defect in the field, or complete blindness; the reflex action of the pupil is impaired. When the nerve is slowly compressed, the loss of sight is followed by slow atrophy of the intra-ocular extremity. When it is invaded by inflammation, this usually descends to the eye, and is visible as intra-ocular neuritis, and may ascend to the commissure, so that the sight of the other eye may subsequently suffer. Inflammation at the back of the orbit usually also involves the motor nerves, and so may cause paralysis of all the ocular muscles. These recover, however, much more readily than does the optic nerve. When the nerve is compressed by narrowing of the optic foramen, the loss of sight is usually accompanied, sometimes preceded, by intra-ocular neuritis. This is also present in most cases in which inflammation extends from the meninges to the intra-ocular part of the optic nerves, the optic chiasma, and even in extension to the optic tract. Damage to the chiasma usually affects the sight of both eyes. In most cases the decussating fibres suffer chiefly or alone, and consequently there is loss of function of the inner half of each retina, and loss of the outer half of each field of vision—*temporal hemiopia*, or *hemianopsia*. Damage to the outer part of the commissure on each side affects the fibres which do not decussate, and so causes loss of function of the outer half of each retina, and so loss of the inner half of each field—*nasal hemiopia*. This is very rare, but has been seen from disease of arterial trunks on each side (Knapp). In irregular damage to the chiasma the loss of vision may be irregularly distributed in the two eyes.

The optic tract receives fibres from the half of each retina on the same side, and its damage thus causes loss of sight in the opposite half of each field of vision—*lateral hemiopia*, or *hemianopsia*. The area affected is often rather more extensive in the eye on the side opposite to the lesion than in the eye on the same side. Since the motor tract, in the adjacent crus cerebri and hemisphere, has decussated at the medulla, if it is also involved in the lesion, there is hemiplegia on the same side as the loss in the field of vision. The patient is unable to see to the side on which he cannot move the limbs. Thus the writer has recorded a case in which a patient had, first, right hemiopia, and afterwards right hemiplegia. Both were due to a small tumour of the inner part of the tempero-sphenoidal lobe, which had first invaded the optic tract and then the crus.

Disease of the corpora geniculata also causes hemiopia.

Regarding the effect of lesions of the fibres which extend from the corpora geniculata to

the posterior part of the optic thalamus and to the convolutions, there is some difference of opinion. It has, until lately, been held, with Von Graefe, that lesions of the convolutions to which these fibres proceed, or of the fibres themselves, cause hemiopia, just as does a lesion of the optic tract. But Charcot has called attention to the fact that hysterical hemianæsthesia, believed to be due to a disturbance of the sensory function of one hemisphere, is commonly associated, not with hemiopia, but with 'crossed amblyopia,' that is, with partial loss of sight of the eye on the anæsthetic side, diminished acuity of vision, restricted field, and the fields for colour-vision are also lessened. These fields vary normally, in extent, for the several colours, and some or all may be so lessened as to cause partial or complete colour-blindness. Similar crossed amblyopia has also been observed as a consequence of organic lesions causing hemianæsthesia, and therefore probably involving the fibres of the posterior part of the internal capsule, outside the optic thalamus. Hence Charcot has put forward the hypothesis that the fibres which pass from the optic tract to the corpora quadrigemina are those which have not decussated at the chiasma, and that in the corpora quadrigemina a complementary decussation takes place, the fibres passing to the other side and there joining the fibres which decussated at the chiasma, so that the convolutions of each hemisphere receive the fibres, not from one half of each retina, but from the whole of the retina on the opposite side, and so the association of crossed amblyopia with hemianæsthesia is intelligible. Hemiopia, Charcot believes, is always due to damage to the optic tract, and diseases of the hemisphere which cause hemiopia only do so by pressure on the optic tract. The facts available as evidence on this question are not very numerous, but they are decidedly opposed to Charcot's theory. Clinically, hemiopia is not unfrequently met with in association with hemiplegia, hemianæsthesia, and occasionally with aphasia, in cases in which there is no reason to believe that there is more than one lesion, or that it is situated elsewhere than in the hemisphere. Such clinical evidence alone is of little weight, but it derives significance from a few reliable pathological facts, in which a lesion near the surface of the brain, such as a hæmorrhage, the size of a walnut, beneath the occipital convolutions (Baumgarten) has caused hemiopia. The symptom has been due to tumours in this situation in many recorded cases, and in one which has come under the writer's notice. These facts make it probable that when crossed amblyopia results from a unilateral cerebral lesion, the effect is due to a reflex rather than to a direct influence. The direct effect of a unilateral cerebral lesion is to cause hemiopia. The same symptom may also result from a lesion of the posterior part of the optic thalamus. Charcot suggests that this always results from tumour or hæmorrhage in this situation, which has compressed the tract. But no case exists which affords support to the opinion that the pressure of an adjacent hæmorrhage on the 'optic tract could cause hemiopia, and two cases have come under the writer's notice—one in a patient of Dr. Hughlings Jackson, who has published the case—in which hemiopia resulted from a simple softening of the pulvinar.

Disease of the corpora quadrigemina has usually caused complete loss of sight in both eyes, but in almost all cases the lesion has been a tumour, which may have compressed the adjacent corpora geniculata, or caused optic neuritis. If Charcot's theory were correct, a lesion here should cause nasal hemiopia, but such an effect has never been observed.

Diagnosis.—The chief points which are our guides in determining the position of post-ocular disease, causing loss of sight, have been already stated. If the affection of sight is confined to one eye, it is probably—and, if associated with unilateral optic neuritis, it is almost certainly—due to disease of the nerve in front of the chiasma. In this case the reaction of the pupil to light is impaired. On the other hand, if the unilateral affection of sight is associated with hemiplegia, and especially with hemianæsthesia, on the same side, it is probable that the disease is in the hemisphere, and the failure of sight is produced in some manner at present unknown. In this case the pupil often acts well to light. Lateral, homologous, hemiopia indicates disease of the tract, posterior part of the thalamus, or white substance between the thalamus and the occipital and angular convolutions, or of these convolutions themselves. In which of these positions it is must be determined by the indications of the localisation of disease of the brain (*see* Convolutions of the Brain and Cortex Cerebri, Lesions of). Nasal or temporal hemiopia indicates disease of the optic chiasma.

Prognosis.—This must be influenced by the position of the disease, and by its nature. When there is simple pressure on the optic nerve, sufficient to abolish sight, the prognosis is very unfavourable. Damage by the extension of inflammation often lessens considerably. In disease of the optic commissure or optic tracts the prognosis is also grave, because the morbid processes, from which these parts suffer, rarely recede. On the other hand, in disease of the hemisphere, considerable improvement often takes place, just as it does in other symptoms. Often, however, the symptom is thought to have disappeared when it still persists in a diminished degree.

Treatment.—The treatment is essentially that of the disease to which the symptom is due, and need not be further discussed in this place.

W. R. Gowers.

**OPTIC THALAMUS, Lesions of.** *See* Thalamus Opticus, Lesions of.

**ORBIT, Diseases of.**—Synon.: Fr. *Maladies de l'Orbite*; Ger. *Krankheiten der Augenhöhle.*—The diseases of the orbit are not numerous, and are almost exclusively surgical in their character. The bony walls of the cavity are liable to be fractured by direct injury, which generally implicates other portions of the skull; the contained tissues are liable to phlegmonous or suppurative inflammation; and the cavity may be the seat of tumours of various kinds, arising either from the walls or from some portion of the contents.

1. **Hæmorrhage.**—Hæmorrhages into the

orbit, excepting as results of injury or from the rupture of aneurismal tumours, are extremely rare; and the few cases which have been recorded have nearly all occurred in persons of generally hæmorrhagic tendency, as one local manifestation among others of a constitutional malady.

2. **Emphysema.**—Emphysema of the orbit is not unknown, and the writer has seen a young man who, in blowing his nose violently, must have ruptured some of the ethmoidal cells, for he distended his left orbit with air, and, in his own words, blew his eye nearly out of his head. The distension soon subsided, and no permanent injury was done.

3. **Inflammation.**—Inflammation of the tissues within the orbit is not a common affection, but it is liable to occur as a complication of fevers and other debilitating diseases, and especially as a complication of erysipelas of the head and face. It is marked by brawny swelling of the eyelids, with some protrusion of the eyeball and some limitation of its movements, the symptoms appearing too suddenly and increasing too quickly to be attributable to the growth of a tumour. The injection of the conjunctiva is generally less marked than that of the lids, and sight is scarcely or not at all impaired as long as the swelling is only moderate in amount. When the injected conjunctiva of the eyeball becomes œdematous, and more especially when the œdema is limited to one sector of the globe, or is much more pronounced over one sector than elsewhere, it is, in the opinion of the writer, an almost pathognomonic sign of suppuration; and the localisation of the œdema will serve as a guide to the position in which pus may be looked for. Other symptoms of suppuration, such as rigors, must of course be taken into account.

Treatment.—As soon as pus is believed to exist, it should be evacuated, since its retention among the orbital tissues may be productive of serious injury, not only to the eye, but also to the ocular muscles and to the nerves which traverse the orbital cavity. The evacuation is usually best effected by introducing a narrow straight knife through the skin, near the margin of the orbit in the selected position, and by thrusting it carefully onward as far as may be prudent, giving the blade an occasional turn upon its axis, to allow of the escape of pus as soon as it is reached. The direction of the point should be governed by complete knowledge of the anatomy of the parts; and it is better to withdraw the blade too soon than to incur any risk of wounding important structures. When it is withdrawn, if no pus follow, the puncture may be carefully deepened or extended laterally by a probe; but it is not necessary to be very strenuous in such endeavours, because if the wound through the skin and fascia be kept from healing by the introduction of a strip of lint, or of a bit of drainage-tube, the pus will soon find its way into the channel of escape thus provided for it. The cavity of the abscess should be syringed out from time to time, according to the amount of discharge, with some suitable astringent or antiseptic lotion; and care must be taken that a free opening is maintained as long as pus continues to be secreted.

4. **Caries.**—In strumous children, caries of some part of the margin of the orbit is not uncommon; and, after the diseased bone has come away, we frequently see much deformity of the lids produced by adhesions between the skin and the deeper tissues, or by the contraction of cicatrices. Many of such cases require plastic operations; but each one, before any operation is undertaken, must be carefully studied in order to discover the most promising method of procedure. In a lad with inherited syphilis, the writer has seen very extensive necrosis of the orbital margin, subsequent to the partial removal and partial absorption, of a large gummatous tumour in the cavity.

5. **Tumours.**—Tumours of the orbit may be cysts (hydatid, dermoid, or sebaceous); lipomata; gummata; sarcomata, originating in connective tissue, and presenting the characters of myxoma, or of the sarcomatous growths distinguished respectively by round and by spindle-shaped cells; or they may be gliomata, springing from the connective tissue of the optic nerve. In other instances they may commence as an apparent hypertrophy of the lachrymal gland; or they may be cartilaginous, or osseous. All alike produce protrusion of the eyeball, and limitation of its movements, together with an amount of disturbance of vision, which depends upon the degree of pressure or of stretching to which the optic nerve is subjected, or upon the degree in which the intra-ocular circulation is impeded. Many of the forms are liable to recurrence, and may thus ultimately destroy life.

Treatment.—All tumours of the orbit alike require removal, if possible, without sacrifice of the eyeball.

R. Brudenell Carter.

**ORCHITIS** (ὄρχις, a testicle).—Inflammation of the testis. *See* Testes, Diseases of.

**OREZZA, in Corsica.**—Iron waters. *See* Mineral Waters.

**ORGANIC DISEASE.**—This expression indicates the nature of a disease in which there is a structural change in the part affected, as distinguished from a merely functional disorder, in which there is no evidence of such change. *See* Disease.

**ORGANS, Displacement of.**—The special malpositions of the chief individual organs are considered in the articles which are respectively devoted to these organs, and it is only intended here to discuss the subject from a general point of view. A distinction is sometimes made between *malposition* and *displacement*, the former including all changes of position, from whatever cause; the latter implying that the organ has by some force been removed from its normal situation after it has occupied it; and the term *dislocation* has also been used in the same sense. For all practical purposes they may be considered together,

Ætiology and Pathology.—The circumstances under which an organ comes to occupy an abnormal position may be thus summarised:—1. The condition may be *congenital*, the organ never having been in its proper place. In this way all or part of the organs occupying the chest and abdomen may be transposed to the

wrong side of the body (*see* MALFORMATIONS). In this connection may also be mentioned the fact that an organ, which some time or other after birth changes its place in the ordinary course of development, may fail to do so, and thus remain in a wrong situation. This may be illustrated by the testis, which occasionally is retained in the cavity of the abdomen or the inguinal canal, instead of descending into the scrotum. 2. A violent strain or effort is liable to cause displacement of an organ, especially if repeated several times. This has been made to account for some cases of movable kidney; and hernia may certainly arise in this way. 3. Malposition may depend upon imperfection in the attachments of an organ. This may be congenital, the attachments being unusually long or loose; or they may become repeatedly stretched from different causes, and thus rendered inefficient. The kidney will again afford an illustration of this cause of displacement, and also the intestines, certain portions of which may come to occupy an abnormal position owing to the unusual length of their peritoneal attachment. 4. Another cause of displacement of organs is to be referred to abnormal conditions connected with orifices or canals, which either remain patent or too large, when they ought to have closed or contracted; or which have been artificially formed, as the result of injury or other causes. Thus, a large inguinal canal and orifice, or non-closure of the peritoneal prolongation, may account for inguinal hernia; or a new opening may be produced in some part of the muscular or tendinous structures of the abdominal wall, leading to some form of ventral hernia; or an opening may remain, or be formed after birth, in the diaphragm, and hence an organ be displaced from the abdomen into the thorax, or *vice versâ*. 5. Pressure is an important cause of displacement of organs. This may come from without, as from wearing tight stays or a belt; but is of most importance in connection with morbid conditions within the body. Accumulations of liquid, gas, or solid, whether the last-mentioned be due to enlarged organs or separate tumours, are frequent causes of malposition of organs, either temporary or permanent. This is well illustrated by the effects of pneumothorax, pleuritic effusion, or an intra-thoracic growth upon the lungs and heart, or even upon certain abdominal organs; and the same thing occurs from similar conditions within the abdominal cavity. 6. Traction is another force which causes displacement of organs. The action of the lung free to expand in cases of unilateral pleuritic effusion has been supposed to aid in the lateral displacement of the heart, by exercising a kind of elastic traction upon it; but this cause is best exemplified by the effects of the contraction of diseased organs upon neighbouring organs, to which they have become adherent. For instance, the heart is frequently altered in its position as the result of a contracted cavity at the apex of the lung, in cases of phthisis. The contraction of adhesions themselves may assist in originating more or less malposition, and they frequently cause the altered situation of an organ to be permanent, by fixing it in its new position. 7. Disease in an organ itself may originate its own displacement. It commonly happens that such disease enlarges or contracts an organ, and thus causes it to pass beyond or to be drawn within its normal limits; but further, an organ may become so heavy as the result of disease, that by its own weight it displaces itself. 8. In the case of certain muscular hollow organs, such as the intestines, excessive or irregular action of the muscular coat may lead to malposition. In this way hernia may be originated, or internal strangulation of the intestine, or intussusception of one part of the bowel into another. In this connection the influence of straining at stool in causing protrusion of the lower part of the rectum may be alluded to. 9. The displacements of the uterus constitute a special group, the causes of which are much discussed. Probably prolonged standing is one element in the causation of some of these displacements in certain cases.

VARIETIES.—The principal varieties of malposition of organs have been casually indicated in the preceding remarks, but it may be useful to arrange them more systematically. 1. An organ may lie in a wrong cavity altogether; for example, the stomach or liver may lie in the chest, or partly in both chest and abdomen. 2. There may be a transposition of one or more of the viscera to the wrong side of the body. 3. An organ remains in its proper cavity, but is more or less removed from its normal position. This may merely be a temporary change, the organ returning to its place when the cause of the displacement is got rid of; or it is a permanent condition, the organ being fixed in its new site. 4. Instead of being fixed, an organ may be more or less freely movable, so that its situation alters with change of posture, manipulation, or other causes of movement. 5. A portion of an organ may pass out of its cavity, so as to lie under the skin or amongst the muscles, as in external hernia; or it may even come altogether out of the body, as happens when organs are protruded in consequence of injury, with an external wound. The displacements named *procidentia* and *prolapsus* may also be mentioned here. 6. In the case of the intestine, one part may alter in its relations to other parts, as happens in the case of invagination. Coils of the bowel also occasionally find their way into curious positions, owing to the presence of bands of adhesion, openings in the mesentery, and other abnormal conditions which predispose to their displacement. 7. The uterus presents special malpositions, both as a whole, and in relation to its different parts, which need not be discussed here. *See* WOMB, Diseases of.

EFFECTS AND SYMPTOMS.—There may be no manifest results whatever of the displacement of an organ, or at least such as can be regarded of much or any consequence. On the other hand, this condition may, if brought about suddenly or acutely, be attended with immediate symptoms of a grave nature. For instance, in the case of the intestine, the passage of its contents is often prevented, and other serious results ensue, familiar enough in cases of hernia; while rapid displacement of the heart may lead to grave

embarrassment of its action, and prevent the passage of blood into the arteries, by altering the relation of their orifices to the cardiac cavities. In chronic cases also displacement of an organ frequently gives rise to phenomena of greater or less importance. Thus, its own functions are not uncommonly disturbed, and may be seriously interfered with, as happened in a case observed by the writer, where the stomach passed through the diaphragm into the thorax. The displaced organ may also produce physical effects, such as irritation or pressure, and thus give rise to pain or other subjective sensations, or to symptoms obviously connected with other structures and organs. Physical examination often reveals malposition of an organ, and this is one of the conditions which should always be borne in mind when examining either of the more important viscera. In some instances it assumes the characters of a tumour, as in the case of movable kidney; and this may prey so much upon the mind of the patient as to lead to considerable general disorder, although the condition may really not be of much moment. It must be remembered that an organ may be diseased at the same time that it is displaced, and then the symptoms are likely to be more marked.

Treatment.—When an organ is suddenly or acutely displaced, and the displacement is attended with serious symptoms, the first aim in treatment should be to get it restored to its normal position as soon as possible. This may be illustrated by the treatment of hernia and other forms of intestinal displacement, or of protruded organs, as the result of injury; and by the removal of pleuritic effusion, by means of aspiration, when it gravely impedes the cardiac action in consequence of displacing the heart. In chronic cases the same principle should be kept in view in the first instance. For this purpose any causes of displacement should be removed, and it may be necessary to employ mechanical means, or even to adopt operative procedures, to prevent a recurrence of the malposition. This may also be exemplified by the treatment of hernia, and of displacement of the uterus. In many cases, however, the restoration of an organ to its normal position is impracticable. Under these circumstances no particular treatment may be required; or perhaps any ill-effects resulting from the malposition may be obviated by the application of a bandage or other means of support, as in the case of movable kidney. Medicinal agents may be of service in combating symptoms, and in improving the general condition, if required. When a malposition is of no consequence, the patient's mind should be made quite easy on the point, especially if any notion is entertained of the existence of a tumour.

Frederick T. Roberts.

**ORTHOPNŒA** (*ὀρθός*, erect, and *πνέω*, I breathe).—A form of difficult breathing, in which the patient is unable to lie down, and is compelled to assume the sitting or erect posture. *See* Respiration, Disorders of.

**ORTHOTONOS** (*ὀρθός*, straight, and *τόνος*, a stretching).—A form of tetanic spasm, in which the body is rigidly extended. *See* Tetanus.

**OSMIDROSIS** (*ὀσμή*, odour, and *ἱδρῶς*, sweat).—A condition of the perspiration in which it yields an unusually strong or fœtid smell. *See* Perspiration, Disorders of.

**OSSEOUS DEGENERATION.**—A kind of degeneration, in which the affected textures assume the characters of bone. *See* Degeneration.

**OSSEOUS SYSTEM, Diseases of.** *See* Bone, Diseases of.

**OSTEITIS** (*ὀστέον*, a bone).—A synonym for inflammation of bone, which may be of various kinds. *See* Bone, Diseases of.

**OSTEOCOPIC PAINS** (*ὀστέον*, a bone, and *κόπος*, fatigue).—Aching pains in bones. *See* Syphilis.

**OSTEOID CANCER.**—This term has been vaguely employed, as implying a cancer including bony structure, or with reference to malignant disease involving a bone. *See* Bone, Diseases of; Cancer; and Tumours.

**OSTEO-MALACIA** (*ὀστέον*, a bone, and *μαλακός*, soft).—A synonym for mollities ossium. *See* Mollities Ossium.

**OSTEO-MYELITIS** (*ὀστέον*, a bone, and *μυελός*, the marrow).—A name for inflammation of the medulla of bone. *See* Bone, Diseases of.

**OSTEO-SARCOMA** (*ὀστέον*, a bone, and *σὰρξ*, flesh).—A sarcomatous growth in connection with bone. *See* Bone, Diseases of; and Tumours.

**OTALGIA** (*οὖς, ὠτος*, the ear, and *ἄλγος*, pain).—Pain in the ear; ear-ache. *See* Ear, Diseases of.

**OTITIS** (*οὖς*, the ear).—Inflammation of the ear. *See* Ear, Diseases of.

**OTORRHŒA** (*οὖς*, the ear, and *ῥέω*, I flow). Discharge from the ear, usually purulent. *See* Ear, Diseases of.

**OVARIES, Diseases of.**—Synon.: Fr. *Maladies des Ovaires*; Ger. *Krankheiten der Eierstöcke; Krankheiten der Ovarien.*

In the article Abdomen, Diseases of, a section is arranged in one of the groups for diseases of the female generative organs, including the uterus and its broad ligament, the Fallopian tubes, and the ovaries. Under the heads Menstruation, Disorders of, and Hysteria, much information may be found upon subjects which might be included among the diseases of the ovaries. But there remains something regarding the pathology, diagnosis, and treatment of ovarian diseases interesting to the physician, without entering upon the more surgical question of such cysts and tumours of the ovaries as call for tapping or ovariotomy.

In proceeding to estimate the frequency and importance of the diseases of the ovaries, we have to consider the wonderful series of periodical processes which go on in women every month for some thirty-five years; sometimes without any interruption by pregnancy, sometimes interrupted by many pregnancies; some carried on to the full period, some interrupted at different stages, followed by lactation for periods variously

prolonged, and perhaps suddenly stopped by the death of the child or by another pregnancy, attended by losses of blood of less or greater quantity, and ceasing usually from forty-five to fifty-five years of age, after more or less irregularity. We have to remember that at each menstrual period one or other ovary becomes swollen; that one or more of its ovisacs enlarges, opens, and admits of the escape of the ovum it contained; that the fimbrial end of the Fallopian tube grasps the ovary, receives the ovum, and allows of its passage into the uterine cavity; that the uterus itself receives an increased supply of blood; and that its mucous membrane undergoes a series of exfoliative changes. We must consider, further, how these periodical processes are associated with much that is of supreme importance in the state of the nervous centres, and in the mental condition of woman; that the normal process, instead of recurring at regular intervals, and ceasing in a few days, may be abnormally prolonged, and may recur at most uncertain periods; and that evolution and involution may be both affected by pregnancy and lactation. When we bear in mind all these highly complex conditions, processes, and relations, the wonder is, not that ovarian diseases should be frequent, but that so many women pass through life without suffering from them. If an ovary become swollen and tender, its blood-vessels overdistended, and extravasation (or apoplexy of the proper ovarian tissue) take place; or if blood escaping into the peritoneal cavity, becomes encapsuled, or forms a hæmatocele of the loose cellular tissue between the layers of one or both of the broad ligaments, we can only wonder that such an accident does not happen more frequently, and be prepared to recognise the effects of repeated slight extravasations. These are uneasiness in the abdomen, increasing to pain, more or less severe, want of sleep, and raised temperature, preceding discharge of blood from the uterus; then swelling and tenderness in one or both groins, bearing down, like labour-pains, recurring at intervals, with discharge of fluid or clotted blood or of membranous shreds; extension of pain to the loins, and irregular flow of urine—all symptoms so often observed as to be almost neglected. And if a vaginal examination is made, especially when combined with examination by the rectum, not only may one or both ovaries be felt larger and lower down than they ought to be, behind and on either side of the uterus; but they may be extremely tender on pressure, and there may be more or less evidence of peri-uterine extravasation. After repeated attacks of this nature, permanent hardening and enlargement of ovaries and uterus, and their impaired mobility, due to organisation of blood-clot or of plastic lymph, are among the most frequent pathological changes which the practitioner is called upon to treat.

The diseases of the ovaries, which will be specially described in this article, are as follows:—1. Abormalities; 2. Displacements; 3. Disturbances of Circulation; 4. Acute Inflammation; 5. Chronic Inflammation; and 6. Tumours, including Cysts.

1. **Abormalities.**—Absence of the ovaries, or their imperfect development, may occasionally be inferred; and the presence of a third or accessory ovary, now and then observed in the dissecting-room and on the operating table, may probably account for the recurrence of regular menstruation in spite of serious disease of both ovaries, or after the removal of both by ovariotomy.

2. **Displacements.**—Congenital or acquired displacements are also observed, as hernia into the inguinal canal, or prolapse to the bottom of Douglas's pouch.

3. **Disturbances of Circulation.**—Hyperæmia, when not excessive, may be considered as an essential part of normal menstruation. A very little excess may lead to the formation of a large clot in an unbroken ovisac, or extravasation into the stroma of the ovary, constituting apoplexy; or between the layers of the broad ligament, or into the peritoneal cavity, thus forming peri-uterine or pelvic hæmatocele. In some cases, apoplexy of the ovisacs is clearly traceable to torsion of the ovary upon its nutrient blood-vessels.

4. **Acute Inflammation.**—Acute oophoritis and peri-oophoritis are probably of much more frequent occurrence than acute orchitis in the male. The testicles are far more liable to mechanical injuries, but are probably not more liable to extension of the poison of gonorrhœa, or its sympathetic effects, and they are free from the periodical hyperæmia which may be regarded as the first step in the process of ovarian inflammation. This periodical hyperæmia, influenced by accidental sudden suppression of discharge of blood from the uterus, is the usual history of an acute attack of oophoritis.

Symptoms.—The symptoms of acute inflammation of an ovary are pain over the pubes, tenderness on pressure in one iliac region, irritation of the bladder, tenderness of the vagina, and pain on moving the cervix uteri, and on passing the finger behind and on one side of the cervix towards the sacro-iliac synchondrosis. In patients with lax tissues, by combined rectal and vaginal examination, the swollen ovary may very often be felt. If one ovary can be felt and moved, the patient at once complains of greatly aggravated pain.

Treatment.—The treatment should consist in absolute rest on the back, with the hips raised and thighs flexed; or on the side not affected, if dry-cupping glasses can be applied over the sacrum. Mustard poultices, or turpentine and chloroform liniment, may also be applied over the sacrum and on the iliac region. The bowels should be well cleared out, and small doses of blue pill and Dover's powder given frequently, with a sufficient quantity of bromide of potassium. Leeching the cervix uteri has been recommended; but the local disturbance caused by it usually does more harm than the loss of blood can make up for. Sometimes the pain is so very severe that it may be necessary to give chloroform or some other anæsthetic, and repeat it more than once before the pain subsides.

5. **Chronic Inflammation.**—Chronic oophoritis, distinguished by those paroxysmal attacks of pain recurring at the menstrual periods, com-

monly known as ovarian dysmenorrhœa, is a much more common condition than the acute form of the disease. And there can be little doubt that both amenorrhœa and menorrhagia may be often due to changes in the ovaries, which are the result of repeated attacks of subacute inflammation. Some turgescence of the mucous membrane of the uterus and Fallopian tubes is a condition attendant upon ovulation; and is physiological or pathological in close relation with the normal or abnormal process in the ovary. So far as anatomical examination teaches us, it is rare to find much change in the ovaries alone, without proof of what is called peri-oophoritis; adhesions between the surface of the ovary and the fimbriæ of the Fallopian tube or the tube itself; adhesions due to pelvic peritonitis; hardening and enlargement of the ovary itself; hard clots in some of the ovisacs; or, on the other hand, a shrivelling, or contraction, or atrophy of the gland.

Treatment.—Whether the chronic form of the disease has succeeded an acute attack—non-puerperal or puerperal—or one or more attacks of gonorrhœa, or repeated abortions, or has merely increased in intensity or duration after repeated recurrence, the treatment must still be the same: namely, avoidance of known causes, rest, attention to the general health, counter-irritation, and the use of sedatives, especially conium and the bromides. In cases of distinct falling downwards of one or both ovaries, an elastic ring pessary, worn in the vagina for a few weeks, is sometimes of signal service. Hard pessaries are not well borne. When all other means fail, the operation of extirpating both ovaries—Battey's operation—must be seriously considered in consultation. We require more facts, accurately observed and faithfully recorded, especially as to the mortality, and to the results obtained by the operation when it does not prove fatal, and the state of the patient's health of body and mind for some years afterwards, before the true value of the operation can be estimated. But enough evidence has been already collected to prove that, after ordinary measures have failed, and morbid physical and mental conditions are clearly dependent on abnormal menstruation, and possibly upon morbid conditions of the ovaries, the physician would be fully justified in advising the patient or her friends to call for the aid of surgery.

6. Tumours.— Of all the diseases of the ovaries, far more common than any malformation or displacement, even more commonly the cause of such suffering as to lead a patient to seek for medical advice than either the acute or chronic forms of ovarian inflammation, or than the ovaralgia or nervous hysterical form of ovarian irritation associated with dysmenorrhœa, and with various forms of eccentricity, and possibly of hypochondriasis, melancholia, or maniacal excitement—common though these conditions may be—cysts of one or both ovaries are the most frequent of all the diseases of these organs. So far as regards their pathological anatomy, for all practical purposes of diagnosis and treatment, they may be divided into *simple* or *unilocular*, and *compound* or *multilocular*—the former a dilated dropsical ovisac, the latter a proliferating cystoma or a dermoid cyst. A still more practical, if less scientific, division might be made into (1) *Cysts*, and (2) *Tumours* of the ovaries, including in the former division such simple or multiple cysts as from the preponderance of fluid and small amount of cyst-wall, may properly be considered as ovarian dropsy—*hydrops ovarii*, or *hydrops folliculorum Graafii*; and in the latter such solid or semi-solid tumours as, under a general class of proliferating cystomata, include pseudo-colloid tumours, myxo-cystoma, cystoid adenoma, sarcoma, fibroma, papilloma, carcinoma, and (as a separate class) dermoid cysts. The histogenesis and the microscopic character of these varied forms of disease must be studied by the aid of special treatises or monographs. Here their clinical history is of chief importance.

Symptoms and Diagnosis. — Clinically the main points for consideration in cases of fluctuating abdominal tumours are whether the fluid is contained within a cyst, or whether it is in the peritoneal cavity, either free or limited by visceral adhesions. In solid tumours the seat and nature of the tumour must be investigated.

The diagnosis between fluid in an abdominal cyst and in the peritoneal cavity has been laid down in the article Ascites. Here it is only necessary to add that the limit of fluctuation as recognised by palpation, and the limit of dulness as ascertained on percussion, exactly correspond when the fluid is encysted. The wave of fluid cannot be made to pass beyond the line of dulness on percussion. But, when the fluid is free, the resonant intestines are float ing in it, and fluctuation may be detected where percussion gives a resonant or tympanitic note. The wave of fluid is not stopped by any cyst-wall.

*Chemical and Microscopical Examination.*—If tapping have been resorted to, in order to give temporary relief to urgent symptoms, or to complete a doubtful diagnosis, chemical and microscopical examination of the fluid affords valuable information. The albumen in the serum secreted by the peritoneum is ordinary albumin, which is coagulated by heat, and will not redissolve in double its volume of strong boiling acetic acid. The albumen secreted by the epithelial layer of an ovarian cyst is that secreted rather by mucous than by serous membranes, known as metalbumin and paralbumin, which (like true albumin) is coagulated by heat, but (unlike true albumin) is re-dissolved, or converted into a translucent gelatiniform liquid, after having been boiled in double its volume of strong acetic acid. Then on examining the deposit which subsides after ovarian fluid has been at rest for some hours, there may be found in the field of the microscope the nuclei of the epithelial cells which line the interior of the cyst. The scales are thrown off, the cell-walls break down, and the nuclei remain. These are the so-called 'ovarian granule-cells' of Nunn, Bennett, and Drysdale, and are characteristic of innocent growth. In addition to these there are found in malignant growths characteristic groups of cells of different sizes, described about the same time by Foulis and Thornton as large pear-shaped round or oval cells, containing a granular material, with one or several large clear nuclei, with nucleoli and a

number of transparent globules or vacuoles. The great variety in size and shape of the cells composing the groups is the characteristic feature. When these large groups are found in fluid removed from a cyst, it is extremely probable that a malignant growth projects into the cavity of the cyst. When the groups are found in peritoneal fluid, there is either some malignant growth, or an ovarian cyst of a malignant character has burst into the peritoneal cavity. Some of the cells have planted themselves upon the surface of the peritoneum, where they have grown and multiplied. Some observers believe that when such groups of cells are found in fluid removed from a cyst or from the peritoneal cavity, the evidence of the malignant nature of the disease is so strong that no other than palliative treatment is justifiable. But microscopic knowledge has certainly not yet reached such perfection as to justify a surgeon in refusing to attempt to save life by removing a tumour, if it can be removed, even if it be characterised by the formation of such groups of cells as have been described. Several such ovarian tumours have been removed after they had burst, and after several tappings of the peritoneal cavity, with the happy result of recovery from the operation and subsequent good health. After the removal of a proliferating cystoma recurrence of the disease has been observed, but there is good ground for believing that recurrence is exceptional.

*Semi-solid tumours.*—Semi-solid ovarian tumours are more common than simple cysts. Instead of a smooth uniform surface, irregularities may be felt, due to cysts, or groups of cysts, of different shapes and sizes, or to thickening of portions of the wall of the main cyst. The wave of fluctuation is interrupted by septa in different directions; and hard nodules, or bone-like projections, may perhaps be detected. Occasionally a deep sulcus between two portions of a semi-solid tumour, with resonant intestine in the sulcus, may lead to doubt whether both ovaries are not affected.

*Solid tumours.*—Ovarian tumours which are entirely solid, not fluctuating in any portion of them, are very rare, but still are occasionally met with, both as innocent fibroma and as true cancer.

*Adhesions.*—Any ovarian tumour—cystic, solid, or semi-solid—may be free from adhesion to the abdominal wall or to the omentum or viscera, or may be adherent anywhere within the abdominal or pelvic cavities. But as the result of ovariotomy is very little affected by the presence or absence of adhesions, a very minute diagnosis of the nature and extent of adhesions is not of much practical importance. Still if there are firm adhesions low down in the pelvis, fixing the uterus, rectum, and bladder together, or fusing them, as it were, into one mass with the ovarian growths, ovariotomy should not be performed, or only after a very guarded prognosis.

*Inflammation*, *hæmorrhage*, and *gangrene.*—Any ovarian cyst, simple or compound, may be the seat of inflammation either on its surface, when the symptoms do not differ from those of peritonitis, or in the cyst-wall or lining membrane, when (without any peritonitis) there may be pain and considerable fever, sometimes followed by rigors and suppuration. Hæmorrhage into one or more of the cyst-cavities may lead to all the symptoms and effects of internal hæmorrhage. Or the whole or portions of the tumour may become gangrenous, from a twisting of the pedicle obstructing the circulation of blood in the vessels of the tumour. In some cases twisting of the pedicle may be followed by a complete separation of the tumour from its ordinary supply of blood. In this condition the tumour is nourished by vessels in the omentum, abdominal wall, or some other structure adherent to the peritoneal coat of the tumour, if the woman's death is not speedily caused by gangrene of the growth.

*Other abdominal tumours.*—The abdominal tumours most frequently mistaken for ovarian tumours are fibroid or fibrocystic tumours of the uterus, and tumours or cysts of the spleen, liver, or kidney. Pregnancy, either normal or extra-uterine, may also be mistaken for an ovarian tumour, or may be present at the same time. It is not rare to find a woman with an ovarian or a uterine tumour to be also pregnant; so that the ordinary signs of pregnancy must be borne in mind in examining any woman who has an abdominal tumour. And the frequency of fæcal accumulations, or of tympanitic distension of the intestines, with thick or rigid abdominal walls and a fat omentum, must also be remembered and excluded, as well as fatty or fibro-fatty tumours which may form in the omentum, or consist of hypertrophied appendices epiploicæ, and fibro-plastic growths, from any part of the peritoneum or sub-peritoneal cellular tissue. Peritoneal hydatids, or hydatid cysts of the liver, spleen, or omentum, retro-peritoneal abscesses, pelvic cellulitis followed by abscess, distended bladder, pelvic hæmatocele, enlarged mesenteric or lumbar glands, aortic aneurism, and enchondroma, are all conditions which must be borne in mind in cases where the ordinary signs of an ovarian cyst or tumour are not sufficiently characteristic to exclude doubt.

But the most frequent source of error is cancer of the peritoneum, not necessarily involving the ovaries, although these organs may not be free from the disease. In some cases the uterus, and both ovaries, and the peritoneum everywhere become covered or infiltrated with cancerous deposits or growths, and in nearly all cases there is considerable accumulation of fluid in the peritoneal cavity. If the coats of the small intestines are involved, the very characteristic signs are manifest of movable tumours, which are both hard and resonant, and which on being pressed or kneaded gurgle under the fingers. In any case of abdominal tumour, with or without peritoneal fluid, where the loss of flesh and strength is rapid, although the tumour may not be large, where there is much pain, and the patient is subject to vomiting or diarrhœa, the diagnosis of intra-abdominal cancer generally proves too true.

Prognosis and Treatment.—1. *Medical.*—It must be confessed that the medical treatment of ovarian cysts and tumours in a curative sense is quite hopeless. In cases of supposed simple cysts, where powerful purgatives and diuretics have been followed by disappearance of the fluid, the true explanation has been either a mis-

take in diagnosis, or an accidental rupture of a thin cyst. In the compound cysts, or the more solid tumours, iodides, bromides, mercurials, and every other remedy that has been tried, has proved useless at the best, and has often injured the general health of the patient without affecting the morbid growth. Beyond attending to the general health of the patient and palliating any urgent symptom, the chief aim of the physician should be to do no harm, to encourage a cheerful state of mind in his patient by the assurance that the disease is curable, and while postponing surgical treatment so long as it is not clearly necessary, not allowing a patient to wait so long that, after unnecessary and prolonged suffering, she falls into a condition unfavourable for the result of an operation.

2. *Surgical.*—If, after exposure to cold, or as the result of a blow or fall, a patient with an ovarian tumour presents the signs and symptoms of inflammatory changes in the tumour or in the peritoneum, rest, fomentations or poultices, and opiates are indicated. If very severe symptoms point to hæmorrhage or cyst-rupture, immediate ovariotomy may afford the only hope of saving life.

In considering the very important question how long a patient should be left to ordinary hygienic or medical treatment without any assistance from surgery, it may be said: 'So long as the patient does not suffer much pain, is not annoyed by her size and appearance, has no great difficulty in locomotion, does not suffer from injurious pressure on the organs of the chest, abdoman, or pelvis, and so long as the heart and lungs, digestive organs, kidneys, bladder, and rectum perform their functions tolerably well, surgical treatment is seldom called for. It is only a projected marriage, or a necessary voyage, or some such family circumstance, that may justify or render expedient earlier resort to surgical aid. Under ordinary circumstances the surgeon would not interfere until an ovarian tumour either distressingly deforms a patient, or seriously impedes her locomotion, or prevents the free action of heart or lungs, or obstructs the circulation through the large veins of the abdomen, or, by deranging the digestive organs, leads to emaciation and weakness, or by its pressure causes pain, loss of rest, or mechanical obstruction to bladder or rectum.' These are the rules laid down by the writer of this article in 1872. Subsequent experience of the ill effects of delay, and of the diminished and diminishing mortality of ovariotomy, lead to the conclusion that these rules rather err on the side of over-caution and too-long delay; and that the welfare of most patients is better promoted by advising an earlier adoption of surgical treatment, and probably the removal of an ovarian tumour, as soon as its nature and connections can be clearly ascertained, and it is beginning in any way physically or mentally to do harm.

In cases of single cysts the question of palliative treatment by tapping, or the radical cure by ovariotomy, must be seriously considered. And when a cyst is really single, the removal of the fluid not only gives great relief for a considerable period, but in some cases fluid does not collect again for several years, sometimes never. Even when a cyst is not absolutely single, but contains one cavity so large that smaller cavities are practically insignificant, tapping may give sufficient relief to warrant its recommendation in cases where patients desire to postpone any more hazardous operation. But in all cases it should be done with the strictest antiseptic precautions against the entrance into the emptied cyst-cavity of atmospheric air, containing any germ or material which may set up putrefactive or infective changes within the body.

Tapping by the abdominal wall, vagina, or rectum, alone or followed by pressure, by drainage, by injection of iodine, by incision, or by the formation of a permanent communication between the cyst-cavity and the peritoneal cavity, in these days can only be regarded as substitutes in cases where ovariotomy is rejected by the patient, or where the surgeon finds that the ovarian tumour cannot be removed. In a very large majority of cases the only hope of cure is in ovariotomy.

*Question of Ovariotomy.*—When it has to be considered in consultation whether a patient should be advised to submit to ovariotomy or not, the chief points for discussion are:—1. How long is she likely to live if left alone, or relieved by palliative treatment only—hygienic and medical—or by tapping? 2. What is the risk of ovariotomy at the average rate of mortality, and how far is the risk in the one patient who is the subject of consultation likely to be above or below the general average?

In reply to the first question, it is believed that after an ovarian tumour has attained such a size as to inconvenience a patient she rarely lives four years—even if relieved by occasional tapping—and that, with due allowance for a few exceptional cases of many years' duration, two years would be the full average expectation of life. Two years of invalid life is what is lost if ovariotomy is done and the patient's death is hastened by the operation.

The average risk of ovariotomy in a large number of cases, including the most and the least favourable, has been diminishing for many years past; and the diminution during the last two or three years has been much greater than before the adoption of antiseptic precautions during the operation. Before 1860 so many unsuccessful cases were concealed, and the numbers who died, of the cases reported, were so great, that the calculated mortality of about 50 per cent., or half the patients operated on, is probably far too small, and it would be more correctly estimated at 70 to 80 per cent. Since 1860 it has been gradually diminishing from 35 to 15 per cent; and since 1878, when antiseptics came into general use here and in Germany, it has fallen below 10 per cent., whilst well-founded hopes are entertained of a still smaller mortality.

Whether any one patient is likely to have more or less than the average probability of ten to one in her favour must depend upon her general health. For the rule holds good, that while the easy removal of small free tumours from women with a feeble heart, or unsound lungs, kidneys, or liver, or shattered nervous system, may hasten death; so may very large adherent

tumours be removed with extreme difficulty from sound, healthy women, and complete recovery may follow, without fever or any unpleasant symptoms; and, most satisfactory of all, perfect health may afterwards be enjoyed for many years, the operation leading to no appreciable modification in subsequent pregnancy or parturition. The removal of one ovary does not appear to affect the number of pregnancies, nor the sex of the children, nor the occurrence of twin pregnancy; and it is quite exceptional to observe that the removal of both ovaries leads to obesity, or any other mental or bodily peculiarity.

T. Spencer Wells.

**OVERLYING.**—Overlying is an accident which, it is alleged, not unfrequently happens to young children, whereby they are killed by suffocation. On an average rather more than 400 children per annum are registered in London as dying from 'overlying' in bed. The post-mortem signs of overlying are those of suffocation. Evidence that a child has really died from this cause is afforded by (1) the post-mortem appearances of death from asphyxia; (2) the absence of any other mortal disease; (3) the absence of evidence of any cause of asphyxia other than overlying.

The statement that a child has been overlain should be received with caution. It is reasonable to suppose that a vigorous child would escape from a suffocating position beneath the bed-clothes, or the body of its nurse, by its own efforts; or at least succeed, by its crying and struggling, in waking its nurse. On the other hand, a very weakly child, whose lungs possibly have only partially expanded, might be killed by a very trifling cause, such as the position of its mouth and nose against the body of its nurse, or the accidental temporary obstruction of its air-passages by the bed-clothes. A medical witness before committing himself to a theory of death from overlying, must consider all the points alluded to above, and must take care not to bring a charge of almost criminal carelessness against a careful nurse, or allow an act of wilful murder to pass under the guise of accidental death.

G. V. Poore.

**OXALIC ACID DIATHESIS—OXALURIA—OXALATE OF LIME CALCULUS.**

1. **Oxalic Acid Diathesis.**—Synon.: Fr. *Oxalurie*; Ger. *Oxalurie.*

Ætiology.—Oxalic acid, when it occurs in the urine, may be derived from various sources. 1. It may come from certain articles of the vegetable kingdom taken as food. 2. It may be derived from imperfect metamorphosis of the waste tissues of the body. 3. It may be due to the conversion of urea and uric acid after the secretion or the emission of urine. 4. It seems to have been proved that oxalic acid sometimes exists in the blood, and may then simply be eliminated by the kidneys.

Characters and Composition.—Oxalic acid in the urine is always found combined with lime, and is recognised thus:—1. As minute octohedral crystals with cross markings. These crystals assume apparently different shapes, according to their varying position in the field of the microscope. 2. As spheroidal, ovoid, or dumb-bell submorphous masses. These latter may be mistaken for somewhat similar bodies composed of lithates, but the colour of the lithates, and the almost invariably concurrent presence of the octohedra, will distinguish them (*see* Microscope in Medicine). The urine containing oxalate of lime is always acid, generally of an amber tint, and contains a faint cloud of mucus. This cloud, however, may be so slight as to be unnoticed, and then the presence of oxalates is apt to be overlooked.

Symptoms.—However derived, the presence of oxalate of lime in the urine frequently, or in any considerable amount, cannot but arrest attention and suggest the question: Is there any special condition of the system dependent on or associated with this occurrence? In other words: Is there any peculiar habit of body to which the term 'oxalic acid diathesis' can be rightly applied? Prout, and especially Golding Bird, so fully described the symptoms of nervous exhaustion, dyspepsia, and hypochondriasis, which are said to characterise this so-called diathesis, and so fully impressed the professional mind with the clinical association of these symptoms with—if not their actual dependence on—oxaluria, that the more accurate and recent observations of Beale, Beneke, and W. Roberts, have scarcely yet succeeded in dissipating the error. These observers have proved that, in the large majority of cases in which the characteristic symptoms are present, no oxalates are found in the urine; and conversely, where oxaluria is most pronounced, the symptoms are absent. Oxalate of lime in the urine is often found in persons enjoying good health. From what has been said of its ætiology, its presence in various chronic diseases, such as phthisis, chronic bronchitis, cardiac lesions, &c., in which oxidation is retarded, is explained. So, too, oxaluria is present in many conditions of deranged digestion and mal-assimilation, and in diseases which lower nervous tone and power.

Treatment.—It will be gathered from the foregoing remarks, that oxaluria demands no direct or uniform therapeutical treatment. The indications are, to obtain perfect digestion by selecting a diet not too rich in nitrogenous or animal food, and by prudence as regards quantity, so that crude or imperfectly assimilated matters are not absorbed; to promote the healthy action of the skin and lungs by sponge or shower-baths, and free exercise in a bracing country or at the seaside; and by tonic remedies to improve digestion, and strengthen the nervous system.

2. **Oxalate of lime calculus.**—Description. Mulberry or oxalate of lime calculus is usually of a dark brown, sometimes almost black colour; generally ovoid or spheroidal in shape; with a rough and tuberculated exterior; and of a hard compact interior. The absolute nucleus is composed of dumb-bell crystals, united by molecular coalescence in, and through the medium of, some viscid organic matter. The influences which control this deposition and growth of calculi have been much elucidated through the researches of Dr. Carter and Dr. Ord, but need not be specially described here. *See* Calculus.

The great insolubility of oxalate of lime

favours the chances of its deposition in the renal tubules. It has been detected in the kidneys of the fœtus; it is especially liable to occur during childhood; and this liability decreases as age advances. In England calculi composed entirely of oxalate of lime are rare in the adult, but in India they are comparatively frequent. Mulberry calculus in the young causes intense suffering; but in the adult, notwithstanding the formidable tubercles and rough exterior, the symptoms of stone are often mild; not improbably because these projections become entangled in the muscular columns of the bladder, and the calculus is thereby fixed in position. The symptoms of renal calculus are fully described in another article. *See* RENAL CALCULUS.

TREATMENT.—Microscopic mulberry calculi, were it possible to detect their existence, could probably be washed away and carried off by diluents and diuretics; but a palpable stone is a subject for surgical treatment only.

W. CADGE.

**OXALIC ACID, Poisoning by.** — *See* POISONS.

**OXYURIS** (*ὀξὺς*, sharp, and *οὐρὰ*, a tail).—SYNON.: Fr. *Oxyure*; Ger. *Spitzschwanzwurm*; *Fadenwurm*.—A genus of nematoid parasites of which the little threadworm or seatworm forms the best known type. Most English practitioners still speak of the common threadworm, *Oxyuris vermicularis*, as belonging to the genus *Ascaris*. In nine cases out of ten, when children are said to be suffering from ascarides, it is meant that they are infested with oxyurides or threadworms. These parasites not only differ from the ascarides proper in respect of size, but also as regards the form of the body, which is more or less spindle-shaped, the tail being sharply pointed. Hence the generic title. Oxyurides infest animals as well as man, the large species of the horse, *Oxyuris curvula*, being almost as injurious to that animal as the little threadworm is to ourselves. *See* ASCARIDES; SEATWORM; and THREADWORM.

T. S. COBBOLD.

**OZÆNA** (*ὄζη*, a foul odour).—SYNON.: Fr. *Punaise*; *Ozène*; Ger. *Stinknase*.

DEFINITION.—Ozæna is generally understood to mean a chronic, highly fœtid discharge from the nose, or its accessory cavities. This discharge, however, and its characteristics, are rather to be regarded as symptomatic of disease, than as disease itself, and is a result of some unhealthy ulceration of the mucous membrane.

ÆTIOLOGY.—The causes of ozæna are various, the most common being syphilis, struma, lupous ulceration, caries, or necrosis of the bones or cartilages, although these may themselves be dependent upon the presence of some foreign body, or other cause of occlusion of the meatus. Ozæna may exist in an idiopathic form, which is regarded by some authorities as depending upon an abnormal condition of the nasal secretion, or as analogous to the offensive odour sometimes met with in the feet or axillæ. Ozæna has been by some attributed to the abuse of mercurials, but more conclusive evidence on this point is wanting.

SYMPTOMS.—The ulceration, on which ozæna depends, generally commences high up in the nose, though it may be first noticeable as low down as the inferior turbinated bone or septum. In the strumous form only one side may be affected, whereas in the syphilitic variety both are generally involved, and there is a greater derangement of health. The diagnosis, however, is rendered the more difficult in children, since it frequently occurs that the two conditions coexist.

The nature of the discharge varies with the case and with its progress, whatever may have been its origin, and it may be influenced by a cold, overwork, or the approach of the menstrual period. It may be either profuse or scanty, thick or thin, purulent or sanious, almost colourless or greenish yellow, and streaked with blood. It often forms crusts, or masses of inspissated mucus, which may accumulate at the posterior nares, being discharged from the nostril as horribly offensive concretions, every few days, and quickly reforming.

The complications consist in the implication of the bones and destruction of the septum, most frequently occurring in the strumous or syphilitic form, so that the nose falls in, producing great deformity.

DIAGNOSIS.—It is of the greatest importance to distinguish between ozæna and the various forms of fœtid breath consequent on bad teeth, ulceration of the mouth and fauces, the presence of foreign bodies or of retarded secretion, or disturbance of the general health—a point which may be readily made out by causing the patient to close the mouth and nostrils alternately, or by rhinoscopic examination.

TREATMENT.—The treatment of ozæna must be both *local* and *constitutional*, and obviously directed to the exciting cause. *Local* treatment consists in the removal of all sources of irritation, by washing out the choanæ, and by the insufflation of powders, although this latter is not so frequently resorted to. The most valuable, undoubtedly, is the nasal douche of Thudichum, the action of which is dependent upon the fact that, while the mouth is kept open, the nares can be thoroughly washed out, and no fluid pass into the mouth, since the velum pendulum palati is closely forced against the upper portion of the pharynx. The instrument itself consists of a tube of varying length, with a perforated nozzle, which is to fit accurately to the nostril. This tube descends from a small cistern, placed at such an elevation that, by turning a stopcock, a current of fluid is injected into the cavity. The fluid used depends on the nature of the case, but is generally some saline solution, such as a weak one of common salt, or salt and carbonate or phosphate of soda; a weak solution of carbolic acid, of Condy's fluid, or of chlorinated soda; or a mercurial in some cases. An ordinary well-made syringe, capable of supplying a tolerably continuous stream, will answer very well in many instances.

Where ulcerating surfaces can be seen or reached, they should be touched by a sponge or camel's-hair brush steeped in a solution of nitrate of silver, nitric acid, or carbolic acid, and the apposed surfaces kept from contact by sponge tents or laminaria. The great pain attendant on idiopathic ozæna may be relieved by applying to the frontal region an ointment con-

taining about 2 or 3 grains of morphia to the ounce. The injection of glycerine is often of great use, especially in strumous ozæna, and it may be combined with a grain of iodine to every ounce with advantage.

With regard to insufflation, or the snuffing up or administration of medicated powders by an instrument, benefit is obtained in some instances from the use of sub-nitrate of bismuth rubbed up with Venetian chalk, or calomel rubbed up with sugar, in the proportion of a grain to an ounce. Tannin, camphor, and cubebs have all been recommended. The principal remedies used in the form of vapour, have been mercurials, such as calomel or bisulphide of mercury, sublimated by a lamp and inhaled. The vapour of hydrochlorate of ammonia is also useful in all forms of ozæna.

With regard to the *constitutional* treatment, in the strumous variety, cod-liver oil, quinine, iodide of iron, and arsenic seem to be of most service.

Those cases which are obviously syphilitic are usually more tractable than either the strumous or idiopathic varieties, under the influence of bichloride of mercury or iodide of potassium, if the patient be robust. In cases where the health is impaired, generous living, with quinine and iron, would be indicated before entering upon specific treatment. EDWARD BELLAMY.

# P

**PACHYDERMIA** (παχὺ, thick, and δέρμα, the skin).—A state of thickening and condensation of the integument, which is sometimes observed in the lower limbs, associated with infiltration and induration. In chronic cellulitis a state of pachydermia is also met with; and thickening of the epidermis, as in the instance of callosity, has received a similar name. But the term is wanting in the scientific precision necessary for its adoption in pathology.

ERASMUS WILSON.

**PACHYMENINGITIS** (παχύς, thick, and μήνιγξ, a membrane).—A synonym for inflammation of the dura mater. *See* MENINGES, CEREBRAL, Diseases of.

**PAIN.**—SYNON.: Fr. *Douleur*; Ger. *Schmerz*.

DEFINITION.—Pain is the representation in consciousness of a change produced in a nerve-centre by a certain mode of excitation. It would seem that some special perturbation of nervous impulses, and not a mere exaltation of the normal functioning of the sensory apparatus, is necessary to the production of pain. For it will sometimes happen, in disease, that whilst the faculty of perceiving painful impressions made upon the skin is wholly, or in great part, lost, touch is felt nearly as well as in health. On the other hand, in hyperæsthesia of the surface, where the slightest impression produces exquisite pain, the power of tactile discrimination is actually diminished.

ÆTIOLOGY AND PATHOLOGY.—Pain is excited by many agencies applied to the skin—mechanical, thermic, chemical, electric, pathological. Of these it is probably only the last which are able to produce pain when applied to the viscera, bones, and blood-vessels. The situation of the stimulus exciting pain may be at any part of the sensory apparatus, from the end-organ in the skin to the central ganglion; but the feeling of pain is always referred to the periphery of the sensory fibre, no matter what portion of the sensory tract has received the irritation. As regards pain, therefore, which is referred to some part of the interior of the body, it must be remembered that the cause (always some pathological agency) may be operating either upon the termination of a nerve, its trunk, or upon the nervous centre in the spinal cord, or superior ganglia. There may be encroachments upon the structure of the nerve-fibre or ganglionic centre, arising from hyperæmia, effusion, or growth in neighbouring tissues.

Pathologically, pain is of at least twofold importance. 1. It causes distress and exhaustion of nervous energy, interferes with sleep, interrupts the appetite and digestion, so that the nutrition of the body is damaged, and thus, if long-continued, it can lead to changes shortening existence; or it may be so severe as of itself to occasion death. 2. Its aid in diagnosis is frequently of higher value than that of any other single symptom.

VARIETIES AND DIAGNOSIS.—It may be useful to refer briefly to a few examples of the diagnostic importance of pain.

*Pain in the head.*—When of a continuous, dull, aching character, pain in the head may be due to rheumatism of the scalp, and this is especially likely if it be increased by bending the head down. A headache of similar character, and affecting the forehead, may be dependent upon gastric derangement. Fixed in one spot, either on the head or face, and darting from that spot, if sharp and paroxysmal, it is likely to be neuralgic. If, in addition, it be accompanied by vomiting and giddiness, it may indicate migraine. Now, migraine much more often than not, endures for a day only at a time, or a little more. If, therefore, these symptoms be continued beyond this period, they should always be regarded with anxiety, as probably connected with brain-mischief. The use of the ophthalmoscope is most important here. Should pain in the head be accompanied not only by vomiting and giddiness, but by squint, or some other evidence of a localised paralysis of a cranial nerve, it is almost certainly due to intracranial disease of a coarse kind—tumour, aneurism, abscess, hæmorrhage, or meningitis. In cases of more or less complete hemiplegia from vascular changes and thrombosis, after the apparent recovery of the patient, more or less fixed pain in the head will often

remain. Whilst this persists, a guarded prognosis is essential, for much more often than not further mischief will follow before long. In all cases of persistent pain in the head, the urine should be carefully examined, not only for albumen, but also for sugar. Pain of a severe kind, especially apt to attack the back of the head, is often found in the course of Bright's disease. It will then be accompanied by albuminous urine; and the ophthalmoscope will very likely show albuminuric retinitis. There is also a form of more or less continuous headache, with occasional violent exacerbations, which accompanies glycosuria.

A recurrent pain in the head, of excessive violence, and described as a feeling as though the bones were being crushed, whilst it may occasionally be due to rheumatism, is far more often dependent upon syphilis. Generally speaking, persistent pain in the head, in a person unaccustomed to it, is a symptom which should always be regarded with anxiety, and the use of the test-tube and ophthalmoscope should never in such circumstances be omitted. This should especially be insisted upon if the patient be a female, and certain concomitant symptoms incline the observer to believe the affection to be hysterical.

In obscure cases the possibility of the toxic influence of lead in causing pain in the head should not be forgotten.

The pain in the head which accompanies chlorosis is often fixed in one spot, and described by the patient as a feeling of a nail being driven into the head. This symptom not unfrequently accompanies hysterical conditions. The pain in the head complained of by school children, as attacking them in their studies, is very often due to some abnormality of refraction or weakness of certain muscles of the eye, which needs the help of an ophthalmologist to investigate. Pains in the head of a darting, shooting character, are sometimes due to locomotor ataxia.

*Pain in the neck.*—This is not at all uncommon, and is usually due to rheumatism affecting the fibrous covering of the large muscles. It is probable, too, that in many cases it depends upon irritation of the loose connective tissue which enables one muscle to glide over another, and which is really an expansion of the lymphatic system. Uric acid, or some equivalent, becoming deposited in this lymphatic space, will excite a little subacute inflammation, and produce a very acute pain. The diathesis of the patient should be inquired into, his urine and evacuations observed, and his mode of living investigated. There may be, too, sometimes pain in the neck from neuralgia. This will be distinguished by its paroxysmal character, and its being independent of muscular movement. Neuralgic pain in the neck is usually accompanied by pain in the district of one or other of the divisions of the brachial plexus in the arm.

*Pain in the chest.*—This may be referred to the chest-wall, or to the interior of the cavity. In the former case it is necessary to determine whether the pain be due to muscular rheumatism, syphilitic periostitis, intercostal neuralgia, or the encroachment of an aneurism or a tumour. Absence of febrile movement, as shown by the thermometer, and the entire dependence of the pain upon movement, point to the first of these causes. A node perceived by the finger upon the sternum, clavicle, or ribs, would indicate syphilitic periostitis. The character of the pain, and the presence of tender points, coupled very probably with a history of previous neuralgic attacks in some other part of the body, suggest intercostal neuralgia. Physical examination will detect or exclude aneurismal tumour. Pleurisy causes a pain referred to the chest-wall, which, as it is particularly marked when the patient coughs, may be confounded with muscular rheumatism or intercostal neuralgia. The elevation of temperature by which pleurisy is accompanied, will ordinarily distinguish it without difficulty, even before there are any auscultatory signs. Continued dull pain deep in the chest may indicate an intrathoracic growth, abscess, or aneurism. Careful physical examination and observation are the means by which the diagnosis of this condition can be made.

Pain is often experienced about the heart more or less early in the course of acute rheumatism. It may be dependent upon commencing peri- or endocarditis, which will be disclosed by the stethoscope. There is a dull, more or less constant pain about the heart, which occurs in conditions of nervous debility, and is not connected with organic disease of the organ. There is also a rather sharp pain just under the mamma, accompanied by cardiac palpitation, which is often complained of by epileptics, and by persons affected with hysteria. It is not accompanied by any evidence of organic change in the heart, and its origin is probably in the central nervous system. Pain in the heart, of an extremely sudden character, as though the muscle were being grasped, and accompanied by intense apprehension of death, with facial pallor and some dyspnœa, points to angina pectoris. The pain is not confined to the heart, but extends to the left arm, and to various parts of the chest. The pains in the chest which accompany various diseases of the lungs and pulmonary tubes will require to be investigated with reference to these conditions.

*Pain in the spinal column.*—Acute pain and tenderness of any of the vertebral spines is a symptom, not of disease of the spinal cord, but of a peculiar state of nervous exhaustion. It is common in hysterical persons, and in others who have from any cause become greatly debilitated. As a rule there is very little pain in the spine in diseases of the cord. In spinal meningitis the patient only complains of pain on movement, and especially if he endeavour to turn over in bed. Pressure upon any part of the vertebral spines usually causes no complaint. There may be a little uneasiness complained of when they are strongly percussed. Pain of an encircling kind, in a sort of band in the wall of the chest or abdomen, accompanied by what is often described as a 'bloated feeling,' is a serious symptom, and points to myelitis. There should be, however, some other confirmatory symptoms, ere this view is decisively fixed upon. In such a condition there would probably be found more or less weakness of the lower extremities, with some cutaneous anæsthesia, below the band of pain. It may happen that an aneurism encroaches

upon the spinal vertebræ, or a malignant growth invades some of them. In such conditions there is often constant and excessive pain, with, not uncommonly, a good deal of tenderness of the surface. The possibility of these conditions should always be borne in mind.

In commencing caries of the vertebræ a 'stinging' pain is often complained of in the chest-wall, and pain may also be complained of on pressing somewhat heavily upon a vertebral spine. In such a case, too, the act of stooping and lifting weights is apt to cause complaint of pain in the spinal column.

*Pain in the abdomen.*—This may, like pain in the chest, be referred either to the abdominal wall or cavity. There may be inflammation and abscess of the abdominal wall. There may be neuralgia of the superficial branches of the lumbar plexus, in which case the pain is paroxysmal, sharp, and may be accompanied by herpes. But pain in this situation is more often myalgic, and will be found to correspond to the insertion of some abdominal muscle, which is subject to overstrain or fatigue.

Acute abdominal pain referred to the contents of the belly, may be dependent upon internal strangulation of the bowel, in which case it will be accompanied by vomiting, constipation, and probably by abdominal distension, with marked peristaltic writhings of the intestines. Or the cause may exist in a hernia which is strangulated. The symptoms in this case will be much like those above described, and therefore it is in all cases of acute abdominal pain with constipation absolutely necessary to make, first of all, a thorough examination, to ascertain that no hernial tumour is to be found. If pain in the abdomen be accompanied by tenderness on pressure, and be increased by coughing, there is probably peritonitis. In such a case the pulse will be found quick and small, and the temperature somewhat, but not necessarily, much raised. The patient will prefer to lie on the back with the knees bent, and the face will betray anxiety. In hysterical women great abdominal pain and tenderness is often complained of, and it is sometimes not very easy to distinguish this from peritonitis. It is best done by engaging the patient's attention, and noting that there is then no evidence of tenderness at a point which had been previously exceedingly painful. The pain and tenderness may be due to enteritis or perityphlitis, in which case there will be obstinate constipation, a tympanitic state of the whole intestine or the cæcum, and most probably vomiting. Cancerous tumours of various abdominal organs will have to be diagnosed by careful palpation, and discriminated from fæcal accumulation. Colic due to the poison of lead, causing violent abdominal pain without rise of temperature, requires to be distinguished from the symptoms which mark the passage of a biliary calculus. Extreme suddenness and severity characterise the latter, and there is usually more vomiting in the passing of a gall-stone than in colic. But the history will have to be investigated, and the evacuations, if any take place, should be examined. The absence of a blue line on the gums should be ascertained ere the possibility of the existence of lead colic is abandoned.

*Pain in the loins and back.*—There are many conditions which give rise to pain in these situations, and which require to be borne in mind in examining a patient. Congestion of the kidneys, or nephritis, will be shown by the scanty, high-coloured urine, containing albumen and probably blood. Renal calculus will be attended by unilateral pain in the loin, following the direction of the ureter, and affecting the corresponding testicle. It is paroxysmal in character, and often horribly severe. The urine will contain blood, and possibly pus, and will be passed very frequently. As between such a condition and the presence of an abscess or morbid growth in the kidney, the points of diagnosis are not strongly marked, and careful observation will be requisite, in order to form an opinion. The presence of a bad stricture in the urethra, by causing retention and over-distension of the bladder with urine, will cause pain referred not only to the hypogastric region, but also to the back.

Lumbago is characterised especially by inability of the patient to rise from his chair without the greatest distress, and only slowly and with difficulty. It may depend upon rheumatism of the muscles, or, still more probably, of subacute inflammation of the connective tissue between the muscles. Or it may be neuralgic in character, in which case it will be acutely stabbing, paroxysmal, and independent of muscular movement.

Pain in the back is frequently caused by flatulent distension of the bowels, and by accumulation of retained fæces. It may be dependent upon a tumour connected with the bowel (especially likely in the sigmoid flexure and rectum), which may or may not be felt by external palpation, or reached by the observer's finger, introduced *per anum*. Nor must it be forgotten that an abscess in the wall of the rectum will cause long-continued and severe pain in the back. It is well to remember that an undiscovered hernia may give rise to little or no inconvenience except pain in the back. So likewise flexions and morbid growths of the uterus, and ulcerations about the cervix, may be the cause of pain, as well as the approach of the catamenial period, which in some women is the cause of great pain in the back.

*Pains in the extremities.*—These may be due to neuralgia, in which case they will be found to occupy the district of one or more branches of nerves, and to be paroxysmal in character. The pains which affect the extremities and the trunk, but especially the legs, in the early stage of locomotor ataxy, are peculiar in this. A patient who has little complaint to make of his health, will every now and then be kept awake all night, and incapacitated in the day, by sudden, sharp, lightning-like pains darting through one or more limbs, and often severe enough to make him call out. They will occur in paroxysms, lasting hours, days, or, less often, weeks; and will subside as suddenly as they began. With such symptoms the patellar tendon reflex should always be tested. Other pains affecting the extremities are rheumatic; or of the nature of the gnawing and aching pains which occupy the joints in acute inflammation from any cause, including rheumatism, and in arthritis deformans. The joints may

also be the seat of pains of a neuralgic character.

Treatment.—The treatment of pain is so involved in the causation, that but little can here be said with advantage on this point. It may be said generally, that pain ought, if possible, to be relieved, for its continuance is exhausting and mischievous to the nervous system. Rest is, as a rule, the first essential. Local applications, in the form of simple poultices, sinapisms, and counter-irritant or anodyne liniments, constitute the most ready means of relieving pain in many cases. Food of a suitable kind will often be the best means of relieving pain, and where the condition of the stomach prevents its being swallowed, it is frequently desirable to inject sustenance by enemata into the bowel. Constipation of the bowels, when accompanied by pain, should never (except perhaps in the case of lead colic) be treated by purgatives. Belladonna, accompanied by minute doses of opium, is the best treatment. The drugs which have the greatest influence as anodynes are, doubtless, opium and chloroform, but belladonna and Indian hemp are often used with advantage. They both require to be used with caution. A habit of increasing the dose of opium (even when it is employed in the form of morphia with the hypodermic syringe) is soon acquired. It is undesirable to allow patients to inject themselves. It is well, in all cases, to begin with a small dose, say gr. $\frac{1}{10}$ morphiæ—a dose which is stimulant and not narcotic. It is the narcotic dose which apparently is followed by a sort of recoil, which suggests the need for a repetition and in larger quantity. T. Buzzard.

**PAINTER'S COLIC.** — Synon.: *Colica Pictonum*; Lead colic; Fr. *Colique des peintres*; Ger. *Malerkolik*.—A form of intestinal colic, due to the presence of lead in the system; so called on account of the frequency of its occurrence amongst house-painters. *See* Colic, Intestinal; and Lead, Poisoning by.

**PALATE, Diseases of.—1. Paralysis.**—The chief causes of paralysis of the palate are diphtheria (*see* Paralysis, Diphtheritic); degeneration of the nuclei of the medulla oblongata (*see* Labio-glosso-laryngeal Paralysis); growths in the basis cranii; and pressure on the nerves of the medulla. The two first usually cause bilateral paralysis. Unilateral paralysis is commonly due to one of the two last causes. Disease of the trunk of the facial nerve is commonly regarded as an occasional cause of paralysis of the palate. But this is certainly extremely rare in facial paralysis, and, in the writer's opinion, its occurrence even is open to question.

Symptoms.—In *bilateral* paralysis the palate hangs flaccid, and irritation of the mucous membrane excites no reflex movements. It is not raised in breathing or phonation; a convenient test is to make the patient utter the sound 'ah' in a high tone; the central palate should be raised by the levator. Deglutition is interfered with, the soft palate being no longer raised so as to shut off the posterior nares; and liquids are forced up into the nose by the contraction of the pharyngeal muscles. Speech is also affected; the resonance of the nasal chambers gives to it the 'twang' which only the *n* and *ng* sounds should possess. The explosive consonants cannot be well pronounced, because the open passage through the nose prevents the air being sufficiently compressed to give the sudden sound when the passage between the lips is open. Hence *p* and *b* become *f* and *v*.

*Unilateral* paralysis of the palate causes little interference with deglutition. The chief muscles which raise the palate meet, it will be remembered, in the middle line of the soft palate, and for this reason one muscle is able to effect sufficient elevation of the whole palate to prevent the regurgitation of liquids. The voice may have a slight nasal twang, but the articulation of the labial explosives is not interfered with. When at rest, the paralysed half is usually a little lower than the other. The uvula is said to be oblique, inclined towards the opposite side. It is, however, sometimes straight in the middle line. A change in form when the azygos contracts may be expected, but is not always to be observed. The chief indication of the paralysis is the unequal movement, which is best recognised during the utterance of the sound 'ah.' The elevation of the middle part being confined to one side, the base of the uvula is drawn a little towards the non-paralysed side, and a dimple forms above the base of the uvula on that side only. By faradisation a difference in the contractility of the muscles may be recognised, but the special apparatus and difficulties of application render this test not one of general application. Unilateral paralysis of the palate is often associated with paralysis of the vocal cord on the same side, and often with paralysis and wasting of the same side of the tongue. This combination is met with especially when there is pressure on the nerves at the anterior part of the medulla. The paralysis of the tongue is, of course, due to disease of the roots of the hypoglossal; that of the vocal cord to damage to the highest roots of the spinal accessory nerve. These nerves-fibres arise in proximity, and the association of these three paralyses (first pointed out by Dr. Hughlings Jackson) constitutes strong evidence that the nerve-supply to the levator palati is derived from one of these nerves.

Diagnosis.—The recognition of bilateral paralysis of the palate depends on its immobility on voluntary and reflex stimulation; that of unilateral paralysis essentially on the inequality of movement in the utterance of certain sounds. Difficulty in diagnosis is due to the frequent inequality of the arches, and obliquity of the uvula. The latter is so common under normal conditions that no weight can be attached to it as an indication of paralysis. The opinion that the palate is sometimes paralysed in facial paralysis rests apparently upon the uvula being found to be oblique, and observers have been strangely puzzled by the frequency with which the uvula deviates to, as well as from, the paralysed side, and have formed various ingenious theories to account for the phenomenon. The writer has never observed any defective movement of the palate or uvula in facial paralysis, although he has looked carefully for it in scores of cases of various kinds. In the face of the strong assertions which have been made, he does not venture to deny its occurrence, but he

is convinced that most of the supposed instances have been examples of natural obliquity.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the palate are those of its causes. Locally the muscles may be galvanised by a long electrode, insulated except at its extremity, and furnished with a contact key, so that the circuit is not completed until the instrument is in position. The difficulty of applying electricity for any length of time lessens, however, its practical value as a means of treatment. Food which is semi-solid is usually swallowed better than liquids.

2. For other diseases of the palate *see* Throat, Diseases of. W. R. Gowers.

**PALERMO, in Sicily.**—Moist, warm, equable, winter climate. Mean temperature winter, 52·7° Fahr. Eighty days' rain. Season, October to April. *See* Climate, Treatment of Disease by.

**PALLIATIVE** (*pallium*, a cover).—A term used in connection with the treatment of disease, when it is directed merely to the relief or mitigation of symptoms. *See* Disease, Treatment of.

**PALLOR** (Lat.).—Synon.: Fr. *Pâleur*; Ger. *Blässe.*

This term, which signifies whiteness or absence of colour, is generally applied in descriptive medicine and pathology in connection with the state of the blood-supply of any part or organ. Pallor then denotes extreme deficiency of that healthy colour of the tissues which is referable to the presence of the red-corpuscles in the capillaries; and indicates anæmia, whether due to contraction of the blood-vessels, diminution in the quantity of blood generally, reduction in the number of red-corpuscles, or relative deficiency of hæmaglobin in the individual corpuscles. In clinical medicine, pallor is most frequently associated with the visible portions of the surface, especially the face, the lips, and the conjunctivæ; or with parts which may be readily seen by special methods of examination, such as the tongue, fauces, larynx, mucous membrane of the nose, and fundus of the eye. *See* Anæmia. J. Mitchell Bruce.

**PALPATION** (*palpo*, I handle gently).—A method of physical examination, in which the hands are employed to appreciate certain conditions perceptible by the sense of touch. *See* Physical Examination.

**PALPITATION** (*palpito*, I beat or throb). *See* Heart, Palpitation of.

**PALSY.**—A popular synonym for motor paralysis. *See* Paralysis.

**PALSY, Shaking.**—A synonym for paralysis agitans. *See* Paralysis Agitans.

**PALUDAL, PALUSTRAL** (*palus*, a marsh).—Of or belonging to a marsh. A term generally used in connection with malarial or marsh fevers, on account of their frequent ætiological association with marshes. *See* Malaria.

**PANCREAS, Diseases of.**—Synon.: Fr. *Maladies du Pancréas*; Ger. *Krankheiten der Bauchspeicheldrüse.*

The pancreas is an organ of great importance in the animal economy, as it produces a secretion of essential value in the process of digestion. Nevertheless, owing to the comparative rarity of its diseases, their frequent association with other lesions when they do exist, the position and relations of the organ in the abdomen, and other causes, it must be acknowledged that perhaps there is no organ in the body disease of which it is more difficult to recognise during life, at least with anything like certainty. At the same time, it may be remarked that if more attention were paid to the pancreas by the general body of medical practitioners, our knowledge concerning its morbid states would probably be greatly increased, and we should have more definite and precise data upon which to form a diagnosis. Many seem to forget entirely that there is such an organ, and even when symptoms or signs point to it with sufficient clearness, at any rate as being the possible seat of mischief, they ignore it altogether, and it never seems to enter into their calculation. The writer's experience has constrained him at the commencement of this article to offer these remarks; but, on the other hand, he feels it his duty to warn against attaching too much importance to the pancreas, and emphatically to express his dissension from all views which attribute the origin of certain special diseases to functional disorders of this organ.

Symptomatology.—Before considering the diseases of the pancreas individually, it will be expedient to discuss generally the clinical phenomena which may arise when this organ is involved. The most striking of these are due, not so much to the implication of the pancreas itself, as to its effects upon other structures with which it is anatomically so closely related; to their being involved in the morbid condition; or to the intimate relation existing between its vessels and nerves, and those of other organs.

1. **Subjective sensations.**—Subjective sensations cannot be said, as a rule, to be of much value in the diagnosis of pancreatic affections. They are often absent, even when there is grave disease; and when present are in many cases of a very indefinite character. As regards their site, the localisation of morbid sensations deep in the abdomen, in the region of the pancreas, a little above the umbilicus, might point to this organ. There is no reliance whatever to be placed upon the influence of changes of posture in modifying them, as has been affirmed. With respect to their nature and causation, it may, in rare instances, happen that pain is felt in the pancreas itself; or there may be merely an ill-defined sense of uneasiness and discomfort, or of weight and oppression. Deep pressure may then bring out more pain or oppression, or these feelings may only be experienced when such pressure is made. More commonly, however, pancreatic disease gives rise to subjective sensations by its effects on surrounding structures. It may cause pain and a more superficial tenderness than usual, by irritating the overlying peritoneum. When the organ is enlarged and heavy, it may produce a sensation of stretching and dragging, amounting occasionally to actual pain, and it is probable that under these circumstances different postures

might influence the sensation, it being most felt in the erect posture. The most important pain, however, connected with pancreatic disease is that due to implication of the solar plexus and its ganglia, of which the writer has met with two striking examples. Sometimes acute inflammation occurs, when the pain is of an acute character; or more commonly the nerves are merely irritated, and this is attended with paroxysms of severe neuralgic pain shooting in various directions, which may amount to extreme agony. In either case there is a feeling of great oppression, restlessness and anxiety, with a tendency to faintness, or actual syncope or collapse. The suffering may be very obvious in the appearance of the patient. In one case the pain was greatly relieved by pressure. It might be supposed that a paroxysmal pain would be associated with the passage of pancreatic calculi, but of its occurrence there is no adequate proof. It might happen that a continuous dull pain arises from erosion of the spine, as the result of pancreatic disease.

2. **Disorders of Secretion.**—It may be regarded as a settled point in physiology that the pancreatic secretion is concerned in the digestion of the starchy, albuminous, and fatty elements of food; and that it not only forms an emulsion with the fat, but breaks it up into fatty acids and glycerine. Hence it might be anticipated that very obvious and definite consequences would arise from any disorder of this secretion, whether affecting the quantity which is formed or which reaches the intestine, or the quality and composition of the fluid. Such consequences have been attributed to pancreatic diseases, though their connection has been by no means clearly proved.

*Hyper-secretion* has been supposed to give rise to a form of pyrosis, the pancreatic juice entering the stomach, and being discharged through the mouth by the act of eructation, as a more or less slimy and viscid fluid; or there being a constant spitting of a fluid like saliva. This has likewise been attributed to salivation, the salivary glands secreting unduly, either from sympathy or vicariously—but this is a mere theory. A form of chronic diarrhœa has also been attributed to excess of pancreatic secretion, which might at the same time be of irritating quality, and this formerly received the name of *diarrhœa* or *fluxus pancreaticus*, and was supposed to be characterised by the discharge in the stools of a quantity of viscid or tenacious liquid. That there is any such special form of diarrhœa is, however, extremely doubtful.

A *deficiency* or *absence* of pancreatic juice from the intestinal canal, or an *abnormal quality* of this secretion, may be attended with phenomena, probably of a more reliable character, although here again caution is needed; among other reasons because it must be remembered that the different secretions employed in digestion tend to make up for each other's deficiencies. It is not unlikely that these disorders may assist in originating symptoms indicating deranged intestinal digestion as well as constipation. More important and definite phenomena, however, have been referred to this cause. The chief of these is the presence of a quantity of free fat or oily matter in the stools, which has not been digested and absorbed, owing to the want of pancreatic juice. By some writers this symptom has been regarded under certain circumstances as pathognomonic of pancreatic disease. It has been found in a considerable number of cases, and experimental investigations lend support to the importance of the phenomenon. On the other hand, it has been chiefly noticed where the entrance of bile into the intestine was at the same time interfered with, and sometimes when this condition alone was present, the pancreas being healthy; while it certainly is not always observed even in grave organic disease of the pancreas, as the writer can testify. The amount of the fat has varied much in different cases, and also its character. It has come away like oil, with scarcely any fæcal matter; or, after standing, oil has floated on the surface of liquid fæces. In other instances lumps of fat have been discharged, white or pale yellow and tallow-like, and the stools have even consisted almost entirely of these lumps. In other cases, again, it has been more or less crystalline; or an oily fluid was discharged, which condensed on cooling, either around the containing vessel, or on the surface of the fæces. It has been observed occasionally that the fat was far greater in quantity than had been taken as food; this has been accounted for by the absorption of fat from the general system, in connection with wasting, to which reference will again be made, and its escape from the vessels into the intestinal canal. Another condition of the stools attributed to want of pancreatic secretion is the presence of an abundance of undigested muscular tissue in them; but it is obvious that this can in no respect be regarded as a reliable sign.

It will not be out of place to refer here to the proved value of the pancreas itself, or of preparations made from it and containing the active principles of its secretion, in aiding digestion in many cases, or in digesting certain foods before administering them, especially according to the plan so admirably worked out by Dr. William Roberts (*see* PEPTONIZED FOOD). This may prove of some consequence in relation to the diagnosis of pancreatic diseases, for it has been suggested that if, with the daily administration of calf's pancreas, the conditions of the stools above described disappear, this is an additional sign of the existence of pancreatic disease.

3. **Symptoms from physical effects.**—The intimate relations of the pancreas to important structures in its vicinity give rise to some of the most striking symptoms associated with its diseases, apart from the mere subjective sensations already referred to. Of these, one of the chief is permanent jaundice, which often becomes extreme, due to closure of the bile-duct. In the writer's opinion this symptom becomes under certain circumstances a most important evidence of pancreatic disease. The pylorus or duodenum are also very liable to be obstructed, thus leading to chronic vomiting, often obstinate, with signs of dilatation of the stomach; by pressure on the body of this organ pancreatic disease has been known gravely to disturb its functions, and even to obstruct its cavity; or it has ulcerated through its walls, and given rise to gastric

perforation and hæmatemesis. The vessels in relation to the pancreas are also important, as being liable to be obstructed, and thus to give rise to symptoms. The veins are especially to be remembered, namely, the portal, superior and inferior mesenteric, and splenic, which may be pressed upon or closed by thrombosis. Hence may arise ascites, intestinal hæmorrhage, enlarged spleen, and other phenomena, although in the writer's experience they have been absent. The vena cava inferior or the aorta may also be more or less compressed, and in the latter case a pulsation or even a murmur may be transmitted through the pancreas, simulating an aneurism; indeed this lesion has been actually caused by the compression of the aorta by an enlarged pancreas. By the extension of pancreatic disease other structures at a more or less remote distance may be interfered with; thus the ascending colon has been obstructed, and also the ureter, leading to hydronephrosis.

4. **General symptoms.**—It certainly happens that pancreatic disease is not uncommonly attended with marked general symptoms, in the direction of wasting, which may reach extreme emaciation, with proportionate debility and anæmia. There are strong reasons for concluding, however, that these do not depend merely on the want of pancreatic secretion, provided the other secretions are in sufficient quantity to make up for it. In those cases in which the general symptoms are observed, there are other causes to account for them, such as absence of bile from the intestine as well as of pancreatic juice, the nature of the disease itself, interference with the passage of food through the pylorus or along the duodenum, the implication of other structures besides the pancreas, or the presence of severe pain, causing much constitutional disturbance. It has been suggested that some cases of so-called Addison's disease, with bronzed skin, are due to pancreatic disease, but this only occurs when the solar plexus becomes involved in a certain morbid process. Patients suffering from grave pancreatic disease are often very low-spirited and despondent. This may be easily accounted for, without attributing any peculiar influence to the pancreas in relation to melancholia and hypochondriasis, a notion which was at one time advanced and entertained.

5. **Changes in the Urine.**—In exceptional cases of pancreatic disease it has been affirmed that fat appeared in the urine as well as in the stools, either in the form of oil-globules, or of a greasy substance, becoming like butter on cooling. This was supposed to be due to the absorption of fat in the process of wasting, but further observations are needed on the subject. More important is the fact that various morbid conditions of the pancreas have been found associated with diabetes. These conditions include chronic inflammatory enlargements, atrophy, fatty degeneration, pancreatic calculi, and cystic dilatation of the ducts. In some instances diabetes follows the pancreatic disease; in others it precedes it. In either case the diabetic condition probably depends, not on the pancreas, but on the implication of the solar and cœliac plexuses and semi-lunar ganglia, which undoubtedly are sometimes concerned in the development of glycosuria. A theory has been advanced to account for the presence of sugar in the urine, founded on the power of the pancreatic secretion in decomposing fats and setting glycogen free, but for this hypothesis there is no foundation.

6. **Physical signs.**—It is only in very rare instances that physical examination can detect the pancreas in health, and most of its diseases do not alter the organ in such a manner as to render such examination of any value in diagnosis. Moreover, even more or less marked physical changes are often difficult to be detected, owing to the situation of the pancreas, and to distension of the stomach, or pushing forward of the liver. It may be affirmed that palpation or manipulation is really the only practicable mode of examination in the investigation of pancreatic diseases, and it must be made when the stomach and transverse colon are empty, and the abdominal muscles thoroughly relaxed. The patient should not only lie on his back, but in some cases help may be derived from placing him on his elbows and knees; and pressure should not merely be made deeply from before backwards, but with both hands laterally from the hypochondriac regions. It may be possible to detect a general enlargement of the pancreas, as a slightly movable swelling, lying across the abdomen in its usual position; but the important condition to be looked for is a tumour of the head of the organ, which is deeply situated, always of small dimensions, rounded, smooth or nodular, usually very firm or hard, and firmly fixed, as if it were rooted in the depths of the abdominal cavity. Even if such a condition were found, however, it would be difficult to associate it distinctly with the pancreas alone, but for all practical purposes it would be sufficient for diagnosis. The possibility of an enlarged pancreas being the means of communicating a pulsation or murmur from the abdominal aorta has been previously alluded to.

Special Diseases.—Excluding certain conditions of the pancreas, which are of little or no practical importance, such as malformations, displacements, and certain exceptional cases of sudden hæmorrhage into its substance, the individual diseases of the pancreas may be conveniently considered under two main groups, namely:—

1. **Acute Inflammation.**
2. **Chronic Diseases.**

1. **Acute Inflammation.** — Synon.: Acute Pancreatitis.—This is an extremely rare disease, and it is one which, even when it does occur, is with great difficulty recognised during life. The results of the inflammatory process vary under different circumstances.

Ætiology.—Acute pancreatitis, as a primary affection, might possibly arise from some injury over the epigastrium, and it has occurred under other circumstances; but the causes to which it has been referred are extremely doubtful, and it is better to acknowledge that we are ignorant as to their nature. As a secondary affection, it has been met with in severe cases of acute febrile diseases, such as typhoid fever and acute tuberculosis; and also in pyæmic and septicæmic conditions of various kinds. It has been affirmed

that pancreatitis has occurred as a metastatic inflammation, in connection with a like condition affecting the salivary glands or testicle; but this is also a very questionable statement.

Anatomical Characters.—These differ under different circumstances. At first usually the pancreas becomes injected and hyperæmic, enlarged, and firmer in consistence; and probably, in some instances, the changes may not go further, the gland returning to its normal condition. Small hæmorrhages may take place into its cellular tissue, or around it, or these parts may become the seat of exudation. Subsequently, in certain forms of inflammation, suppuration is liable to ensue, either in the form of a purulent infiltration, or of one or more abscesses, beginning in the latter case as separate points of suppuration, which afterwards enlarge and coalesce. It is a matter of dispute whether the pus is formed within the ducts and acini, or in the cellular tissue. In rare instances gangrene has occurred, and, it would seem, especially where there have been hæmorrhages. From mere irritation, or the bursting of an abscess, peritonitis may be set up. In the form of pancreatitis occurring in febrile diseases, the inflammation assumes a parenchymatous form, other organs being similarly affected, a so-called acute parenchymatous degeneration taking place, and the gland becoming filled with granular and turbid material, of an albuminoid nature.

Symptoms and Diagnosis.—In certain cases acute pancreatitis occurs under circumstances in which no clinical indications whatever of such a disease can be expected, or at least any of a definite nature. The earlier symptoms, which might lead to the suspicion of pancreatitis, are deep-seated pain in the epigastrium, with gastric disturbance, and some degree of pyrexia. Possibly the slighter cases may subside after this, and recovery take place. In those cases, however, in which the presence of the disease has been verified, the pain has speedily become intense and continuous, and either of a dull character, or shooting towards the back or shoulder. This was accompanied with deep tenderness, and tension of the epigastrium, preventing examination being made. The gastric symptoms became more marked, including eructations, nausea, and vomiting of a thin or viscid liquid, often containing bile. There was thirst, and the bowels were constipated. Other symptoms included great restlessness, præcordial anxiety, hurried breathing, and a tendency to syncope, with weak pulse. In fatal cases the symptoms rapidly became worse, and death was preceded by the usual signs of collapse. Most of these phenomena have been attributed to implication of the solar plexus. Signs of peritonitis might arise. The diagnosis of acute pancreatitis must always be extremely uncertain, but in endeavouring to make it, it is important to try to exclude acute gastritis or duodenitis, and conditions connected with the liver or bile-ducts. This affection does not seem ever to cause jaundice.

Treatment.—But little can be definitely said on this matter. The most obvious indications are to keep the patient at rest; to give only small quantities of liquid food; to relieve the pain and gastric symptoms by means of ice, effervescents, with hydrocyanic acid, opium, or morphia, and other suitable remedies; to open the bowels; and to give stimulants for the support of the patient, when these seem to be called for. Ice, or, on the other hand, fomentations or poultices, might be applied with advantage over the epigastrium in different cases; and it has been recommended to apply a few leeches. Peritonitis must be treated if it should be set up.

2. **Chronic Diseases.**—It will be most convenient to indicate, in the first place, the nature and origin of the several chronic diseases of the pancreas; and then to discuss as a whole their clinical relations and treatment.

(*a*) *Changes affecting circulation.*—Under this head it will only be necessary to mention that, in cases of general anæmia, the pancreas suffers along with other organs; that in all conditions which impede the portal circulation, whether in connection with the liver, or with the heart or lungs, this organ becomes the seat of mechanical venous congestion and its consequences; and amongst the latter hæmorrhage is to be noted, which occurs in separate points, the blood subsequently undergoing changes, and its sites being indicated by altered pigment, or by spaces containing coloured serum, and having pigmented walls. Considerable hæmorrhages, leading to the formation of apoplectic cysts, may take place into the pancreas, as the result of rupture of a diseased artery. A peculiar form of hæmorrhage has been observed in connection with this organ, in which it becomes hæmorrhagic throughout, and no marked change can be found in its substance or in its vessels. Cases of this kind seem to be sudden in their onset, and rapidly prove fatal, but their nature and the real cause of death are undetermined.

(*b*) *Changes in growth.*—Many cases of either general or partial hypertrophy of the pancreas have been described; but some writers doubt the reality of a true hypertrophy or hyperplasia of the glandular elements, and maintain that the increase in size and weight of the organ in these cases was due to an increase in the interstitial tissue, or to other causes. This is one of the conditions said to have been observed in connection with diabetes. Atrophy is an undoubted morbid condition to which the pancreas is liable. It has been observed as the result of old age; in cases of general wasting from various causes; in connection with diabetes, where it may become extreme; or from certain local causes, namely, pressure upon the gland by morbid conditions in its vicinity, or by diseases within the organ itself. The degree of wasting varies; but it may be so considerable that nothing is left except a fibrous cord indicating the former site of the pancreas. In lesser degrees the change is often associated with more or less fatty degeneration.

(*c*) *Chronic Inflammation.*—That the pancreas is subject to a chronic inflammatory process cannot be doubted, but it is by no means clear what should be included under this term. The condition usually recognised, and which is most common, is that in which the organ becomes more or less cirrhotic or fibroid, either throughout its whole extent or in some portions of it; the head is very liable to be thus affected. The changes

essentially consist in an increase of the interstitial connective tissue, with wasting of the glandular structures, and the organ becomes proportionately indurated, dense, firm, and tough, and may be granular or irregular. Distinct tracts of connective tissue may be visible. This form of chronic pancreatitis may in various degrees result from prolonged venous congestion; chronic alcoholism, especially indulgence in strong spirits; retention of the pancreatic secretion, with dilatation of the ducts; the irritation of morbid growths, such as cancerous or syphilitic growths; or neighbouring disease, which affects the pancreas either by directly spreading to it, or by causing pressure or irritation. In some of these cases a chronic parenchymatous inflammation seems also to be going on.

Very rarely the pancreas becomes the seat of chronic suppurative inflammation, either by extension from parts around, or from conditions in the organ itself, such as the presence of calculi or the formation of cysts. The pus either infiltrates or collects in one or more abscesses, and the latter may burst into the abdominal cavity or other parts, or dry up and become calcareous. Caseous masses, following chronic inflammation, may form in the pancreas, associated with similar products elsewhere, in cases of scrofulous or tubercular disease.

(*d*) *Degenerations.*—The pancreas is liable to the usual two forms of fatty change, namely, a *fatty hypertrophy* or *infiltration*, associated with obesity, which, though affecting the interstitial tissue, may eventually cause complete wasting of the glandular structure by pressure; and *fatty degeneration*, which affects the gland-cells themselves; or the two conditions may be associated. In simple fatty degeneration the organ becomes gradually smaller, softened, and flaccid; pale or whitish-yellow or brownish; but its acini are distinct. A fatty emulsion may form in the ducts. The products of degeneration are absorbed or discharged, and coincident atrophy takes place, so that at last the organ may entirely disappear. This degeneration has been noticed as the result of alcoholism, in wasting diseases, and in cases of diabetes.

Amyloid disease may affect the pancreas, but it cannot be said to be of any practical consequence.

(*e*) *Morbid Growths.*–Cancer is the most important disease affecting the pancreas. The growth is usually of the scirrhous variety, rarely of an encephaloid, a melanotic, or a colloid nature. In most cases it is secondary, the organ being usually involved by extension from neighbouring structures, or now and then a distinct growth being formed; but it also occurs as a primary affection. Pancreatic cancer is decidedly more frequent in males than females, and it is rare under forty years of age. The writer has, however, known it to occur in a young man twenty-three years old. Primary cancer has been attributed to injury over the epigastrium. As a rule the head is first implicated, rarely the body or tail; often the disease remains confined to the head, but in other instances it spreads, so as finally to involve the entire organ, or separate deposits form. When the morbid condition is confined to the head, it presents a more or less rounded tumour, varying in size, but never attaining large dimensions; somewhat irregular or nodular; very dense and hard in consistence; and whitish on section. If the entire gland be affected, similar appearances are evident throughout its whole extent; but, if not, the unaffected portion may be the seat of atrophy, chronic inflammation, or dilatation of the ducts, with the formation of calculi. Distinct small tumours are found in some instances. If the cancer be of other kinds than scirrhus, it will present the characters peculiar to each. Usually it exhibits under the microscope the structure of scirrhous cancer, there being a large amount of fibrous stroma.

Pancreatic cancer always affects, in some way or other, neighbouring structures. It may simply press upon them; or it causes irritation, and thus sets up chronic inflammation, becoming adherent to various parts; or the cancer may spread; or destruction and ulceration take place, involving the duodenum, stomach, vessels, peritoneum, diaphragm, vertebræ, or other structures; but not uncommonly the parts are found so matted together at the post-mortem examination, that it is impossible to separate them, or to say where the disease began. The consequences of the secondary effects of pancreatic disease have already been pointed out, and need not be further discussed here, except to remark that the obstruction of the bile-duct, which is a frequent event, seems to be due, not so much to pressure as to contraction at the orifice or along the course of the duct, the result of chronic inflammation.

As rare morbid growths found in the pancreas, it will suffice to mention sarcoma; tubercle, either as a caseous nodule, or in the form of granulations; and syphilitic formations, which may be of the nature of gummata, or of a cicatricial tissue, involving the gland generally or locally.

(*f*) *Obstruction and Dilatation of the Ducts—Cystic formations.*—The main duct of the pancreas—canal of Wirsung—may be obstructed at or near its orifice; or some of its divisions may be thus affected. The former depends either upon conditions outside the gland, causing pressure, such as tumours in the vicinity, enlarged glands, a large gall-stone in the bile-duct, or thickening and adhesions due to inflammation; or upon conditions in the gland or duct itself, namely, malformations causing a bending of the duct, calculi, new growths, chronic interstitial inflammation, or catarrh of the duct. One or other of these conditions also accounts for any localised obstruction. The effects of the obstruction will be to produce retention of the secretion, with dilatation of the main duct and all its branches, either uniform or unequal, or of limited portions of these, according to the seat of the impediment; and ultimately one or several cysts usually become developed, which may attain a considerable size. In the early stage the contents resemble more or less the ordinary pancreatic secretion, but subsequently they become either serous, purulent, hæmorrhagic, caseous, or cretaceous. The walls of the cysts become thickened and indurated, and, by encroaching upon the substance of the pancreas, at the same time setting up chronic interstitial inflammation, they may ultimately cause complete destruction of the organ. These conditions have

been occasionally found in connection with diabetes. In rare instances pancreatic cysts have been known to rupture into the stomach or duodenum. They have originated, in exceptional cases, from hæmorrhage into the pancreas.

(*a*) *Calculi and Parasites.*—Calculi occasionally form in connection with the pancreas, either in its main duct, or, less frequently, in the divisions, or in both places. There may be but one, or a large number. They may be very minute, or attain the size of a nut or walnut, or even larger dimensions. The concretions are usually white, or greyish-white, occasionally dark or blackish, round or oval in shape, rarely branched, and smooth or rough on the surface. As a rule they consist mainly of calcic carbonate or phosphate, or of both salts; very rarely of solidified protein substances. They originate from the pancreatic juice, the inorganic constituents of which are precipitated, usually owing to its retention; but it is supposed that the products of catarrh of the ducts, or an abnormal composition of the secretion, may also be the primary cause of the precipitation which leads to the formation of pancreatic calculi. Their effects have been already pointed out in the description of the preceding diseases, and it will suffice to mention that the principal conditions they are liable to produce are dilatation of the ducts and cysts; inflammation leading to abscesses; chronic interstitial inflammation and its consequences; or inflammation in the structures around. They probably escape in some instances through the canal of Wirsung.

As regards parasites, it will be enough to state that roundworms occasionally find their way into the pancreatic duct.

Symptoms.—It will be easily understood that most of the cases of chronic disease of the pancreas are unattended with any symptoms drawing attention to this organ, or with such as are at all characteristic, while a large number present no symptoms whatever, being latent from first to last, the lesion being only discovered at the *post-mortem* examination. Moreover, in the case of the affections which might be expected to originate prominent symptoms, they are so often associated with morbid conditions of one or more of the other organs concerned in the digestive process, or of other structures, that it frequently becomes most difficult or impossible to assign to each its share in the production of the phenomena observed. Under any circumstances, several of the chronic pancreatic diseases which have been described can only lead to more or less derangement affecting the formation or escape of the secretion, and all of them tend to produce this result, so that symptoms might be expected to arise from this cause, but those which are regarded as at all significant, whether of excess or deficiency of pancreatic juice in the intestines, are only present in comparatively few instances, even of those complaints which are of a grave character.

In addition to what has just been stated, it will only be necessary further briefly to allude to other points in the symptomatology of those pancreatic affections, in connection with which more evident clinical phenomena might be anticipated; the explanation of the symptoms has already been sufficiently discussed.

*Chronic inflammation* may be attended with deep-seated epigastric pain and tenderness, constant or increased paroxysmally. It certainly tends to be complicated with symptoms due to pressure on neighbouring structures, or their implication in the inflammatory process, such as jaundice, ascites, or signs of obstruction of the pylorus or duodenum; and glycosuria might possibly set in. It very rarely happens that the enlarged pancreas, or its head, can be detected on physical examination. More or less general wasting might be present.

*Cancer* is by far the most important disease of the pancreas, and the one most likely to give rise to symptoms of a somewhat definite character, though even here there is often much uncertainty. Deep-seated epigastric pain is a very frequent symptom, at some period or other in the course of a case, and it has been regarded as of much importance; but it must be remembered that it may be absent from first to last, or may only come on late in the progress of the disease. This pain is also characterised by its intensity, and the difficulty experienced in relieving it. It is usually more or less constant, and of an aching or gnawing character, or lancinating, shooting across the epigastrium, especially towards the right, or backwards towards the shoulder, or all over the abdomen. Sometimes a sensation of burning, or of tightness and dragging is described. An important feature often observed in connection with this pain is that it tends to become greatly aggravated in paroxysms, of which the writer has seen some striking examples, where the attacks were most agonising and almost unbearable. It may be influenced by food, coughing, deep breathing, movement, or posture. It is in some instances decidedly worse in the erect and supine postures; and during the paroxysms the patient may bend forward, and press upon the epigastrium, in order to obtain relief. Gastric symptoms are usually prominent in cases of pancreatic cancer, especially nausea and vomiting, and eructations, much importance being attached by some writers to the occurrence of an abundant watery pyrosis. The tongue frequently continues clean and moist throughout. The bowels are constipated, and fatty stools may be observed; but they are by no means constant. Thirst is sometimes a marked symptom. Jaundice and other phenomena indicative of interference with neighbouring structures are of common occurrence, and jaundice may be the most prominent symptom in cases of cancer of the pancreas. Physical examination is of essential importance in the detection of this disease, and it should be made again and again in doubtful cases, under the most favourable conditions obtainable. In many instances, however, nothing can be detected, at any rate of a definite character; or there may be only a sensation of undue firmness, resistance, or induration. Sometimes the enlarged organ may be made out; or a tumour of the head, having the characters already described. The general symptoms are always of a serious character, namely, emaciation, anæmia, weakness, and depression, and they often become extreme. There may be distinct signs of the cancerous cachexia.

*Cysts* in the pancreas in rare instances attain

such a size as to cause an enlargement perceptible on examination, in the form of a deep-seated tumour, rounded and smooth, soft, and perhaps yielding a sense of fluctuation. Pressure-signs might be present; but in the cases observed there has been little or no pain, and general symptoms were absent or slight.

*Calculi* in connection with the pancreas are almost always latent, but they may produce secondary effects causing symptoms. There is no authentic history of any case of colic from the passage of a pancreatic calculus into the duodenum.

Diagnosis.—Sufficient has been said in discussing the symptoms to indicate how difficult or impossible it must be to diagnose positively, in the great majority of cases, the existence of chronic disease of the pancreas. Cancer is the affection most likely to be recognised; but some of the others might be suspected under certain circumstances. What has been stated will explain how they are to be distinguished from each other, but it is often very difficult to diagnose between chronic pancreatitis and cancer. With regard to the diagnosis of pancreatic lesions from those affecting some neighbouring structure, it must be remembered that they are liable to be involved together, and it may then be of little practical moment to determine precisely what structures are implicated. It is necessary to be particularly cautious against referring symptoms connected with the liver or stomach, induced by pancreatic disease, to a morbid condition of either of these organs; while it must always be borne in mind that enlargement of the liver may result from accumulation of bile, due to obstruction of the hepatic duct; and also that dilatation of the stomach will follow narrowing or closure of the pylorus or duodenum. It may be stated as a general rule that serious disease of the liver or stomach will probably reveal itself by obvious signs; and if this can be excluded in certain cases, the diagnosis of pancreatic disease will be appreciably aided. The painful paroxysms connected with pancreatic cancer may readily be mistaken for the passage of gall-stones, if jaundice should be present. If a tumour should be felt, it may be difficult to distinguish it from an omental tumour. When distant effects are produced, such as hydronephrosis, the diagnosis becomes almost impossible. It must be remembered that a pancreatic tumour may present pulsation and bruit, conducted from the aorta, and thus simulate aortic aneurism. In conclusion, the writer would insist once more, as bearing upon the diagnosis of pancreatic disease, on the importance of remembering that there is such an organ as the pancreas; and also of making a thorough physical examination, again and again if required, in any case in which disease of this organ is suspected.

Prognosis.—But little need be said under this head. Even if certain forms of pancreatic disease should be recognised, they may not affect life, but no positive opinion can be given. It has been affirmed that chronic pancreatitis is curable in the early stage, but of this there is no real proof; it probably aids in bringing about a fatal result sooner or later in those cases in which it exists. Pancreatic cancer is necessarily a fatal disease, and it usually terminates in death within a year after the symptoms have become prominent.

Treatment.—The indications in the management of cases of chronic disease of the pancreas are within a very limited compass, even if it should be recognised. Rarely can there be any possibility of curative treatment being effectual, although supposed cures of chronic inflammation have been brought forward, obtained by the administration of calomel, to act upon the pancreas, of saline purgatives, or of mineral waters of this class; or, when there has been a syphilitic history, by the use of mercury to produce its constitutional effects, or of iodide of potassium. In many cases the employment of saline aperients would be beneficial, to keep the intestinal canal free, and to unload the portal circulation. An occasional dose of calomel or blue pill might also be advantageous. In the large majority of cases of pancreatic disease the treatment would have to be chiefly symptomatic, directed especially to the relief of pain, to the symptoms connected with deranged digestion, and to the state of general wasting and debility. Hence, every case must be treated on its own merits, in accordance with well-understood principles. For the relief of the severe paroxysms of pain attending pancreatic cancer, subcutaneous injection of morphia is the most reliable remedy. The use of digestants, particularly as recommended by Dr. William Roberts, would probably prove of considerable practical value in the treatment of cases of chronic pancreatic disease. Sweetbreads might be employed as an article of diet; or pancreatic emulsion, or liquor pancreaticus, might be given; but the previous digestion of the food by means of Benger's liquor pancreaticus is the plan likely to be followed by most benefit, and from this plan great advantage might be anticipated in appropriate cases. Frederick T. Roberts.

**PANDEMIC DISEASES** (*πᾶν*, all, and *δῆμος*, the people).—Epidemic diseases which affect groups of several countries or the world generally. *See* Epidemic; and Periodicity in Disease.

**PANTICOSA, in the Spanish Pyrenees.** Thermal Waters. *See* Mineral Waters.

**PAPILLOMA** (*papilla*, a nipple, a wart). A tumour composed of hypertrophied papillæ, either of the skin, or of a mucous or a serous membrane. *See* Tumours.

**PAPULA** (Latin).—Synon.: Pimple; Fr. *Papule*; Ger. *Papel*.

Definition.—A minute prominence of the skin, for the most part conical, but often round, and sometimes flat; and resulting from vascular congestion, hypertrophous growth, or accumulation of secretions.

A rude kind of distinction might be drawn between inflammatory pimples and non-inflammatory pimples. In the classification of skin diseases adopted by Willan the term *papulæ* represents a group of pimply affections; and he defines the word *papula* as follows: 'A very small and acuminated elevation with an inflamed base, very seldom containing a fluid or suppurating, and commonly terminating in scurf.' He thereby gives the word pimple a special signification, which is highly objectionable. A

more correct view of pimples would be to regard them in their several relations to vascular congestion, abnormal growth, and retained cutaneous products. A typical papula is presented to us in *cutis anserina*, where the pore of the skin or aperture of a follicle is projected outwards, in consequence of a certain rigidity, which opposes the contraction of the interporous tissue. This may be considered as a physiological papula; but the pathological papula is similarly located in the follicle of the skin, the prominence being produced by congestion of the vascular coat of the follicle, with more or less exudation into its capillary network. Such is the precise pathology of lichen; and this condition, with accumulation of follicular contents, constitutes conical acne.

A papula from hypertrophy of tissue may be illustrated by acrochordon, minute verrucæ, and milium; and a papule from accumulation of cutaneous products, by acne punctata and imperforate follicles. ERASMUS WILSON.

**PARACENTESIS** (*παρὰ*, through, and *κεντέω*, I prick).—SYNON.: Tapping; Fr. *Paracentèse*; Ger. *Paracentese*.

DEFINITION.—The operation of tapping any cavity, to draw off fluid or gas.

The term is usually confined to operations on the peritoneum, pleura, pericardium and cranial cavity; the tapping of cystic tumours not being included. Most of these are now performed with the aspirator (*see* ASPIRATOR.) All those here described are performed with the cannula and trochar. The more extensive operations on the pleura, such as antiseptic opening, free drainage, trephining the ribs, &c., are described with the diseases which necessitate them. *See* PLEURA, Diseases of.

INSTRUMENTS AND OPERATION.—The best form of instrument for tapping the pleura or peritoneal cavity is that known as Thompson's syphon trochar. In this the cannula is fixed to the handle, and has a lateral opening about its middle, to which a long india-rubber tube is attached. The trochar is continued through the handle of the instrument and terminates in a button. In the handle the stem of the trochar is surrounded by air-tight packing. The instrument is inserted in the ordinary way; the trochar is then drawn back till its head is past the lateral opening in the cannula, through which the fluid will then flow. The india-rubber tube must be carried into a vessel containing carbolic acid solution (1 to 40). The result is that a syphon action is established, of sufficient force to exhaust the cavity operated on, and at the same time the accidental entrance of air is rendered impossible. Should the instrument described not be at hand, the following simple plan, suggested by Reybard, will be found very efficient. The cannula immediately below its external extremity is surrounded by a linen petticoat, from two to three inches in length, which is well soaked in carbolic oil (1 to 10) before the instrument is used. On withdrawing the trochar the petticoat hangs down, forming a channel through which fluids readily pass outwards, but which collapses instantaneously if there is any tendency to the entrance of air. This is especially useful in tapping the pleura. The same result can be obtained by applying a large veil of lint or rag, soaked in carbolic oil, over the cannula the moment the trochar is withdrawn. In tapping the cranial cavity or the pericardium very fine instruments, usually known as *exploring trochars*, must be used. In some cases, when the ribs are very close together, a flat cannula with a lancet-shaped trochar, may be useful. Before using a trochar it should be passed between the finger and thumb to feel if the free edge of the cannula is perfectly concealed by the wider head of the trochar. This is frequently not the case with old instruments, in which the cannula has lost the spring given to it by the two slits at the end. If the cannula project it may push the pleura before it, the head of the trochar only entering the cavity. A cannula and trochar should be always kept separate when not in use, to prevent rusting, and the head of the trochar should be well pushed into a soft cork. A blunt or rusty trochar doubles the suffering of the patient. Immediately before use the two parts of the instrument should be separately well washed with carbolic acid solution (1 to 20), or with some other powerful antiseptic, and the trochar will enter more easily if it is greased with carbolic oil (1 to 10). These precautions are of the utmost importance. A dirty instrument has often caused the death of the patient, by exciting decomposition in the cavity operated on; and real cleanliness can only be ensured by dipping the instrument immediately before use in some powerful antiseptic. A perfectly bright and apparently clean instrument may be in reality coated within and without with microscopic dirt, which antiseptics alone can render innocuous.

In using a trochar the instrument is held under the hand with the end of the handle in the hollow of the palm; the thumb is placed upon the rim of the shield of the cannula, ready to push it off without necessitating the employment of the other hand, and the forefinger is firmly pressed against the side of the cannula, at the point to which it is intended to limit the advance of the instrument. No preliminary incision is required if the instrument is in good order. It will only double the patient's pain and increase the risk of non-union of the wound. It is advisable to draw the skin aside from its normal position before introducing the trochar, so that the superficial and deep parts of the puncture may not correspond when it is withdrawn. A valved opening is thus made, which can hardly fail to close readily.

PRECAUTIONS.—When either of the large cavities is tapped, if a large quantity of fluid is rapidly removed, the patient is apt to become faint. These operations should, therefore, be always performed in the recumbent or semi-recumbent position, and stimulants should be at hand, the patient being carefully watched. Should faintness occur the operation must be immediately suspended. If the patient fears the pain of the puncture, the skin may be frozen, either by the ether-spray apparatus, or by the application of a piece of ice dipped in salt.

1. **Paracentesis Abdominis.**—This term is usually applied exclusively to the operation of tapping the peritoneal cavity for ascites, or, in very rare cases, for free gas. When the trochar

is used for the relief of a distended bladder, or to empty an ovarian cyst or a hydatid of the liver, the simpler term 'tapping' is invariably used. The operation for ascites is performed in the following way:—the patient must be made to empty the bladder immediately before the operation; if there is the remotest possibility that this cannot be done perfectly by natural means, a catheter must be passed. A strip of flannel wide enough to reach from the nipples to the pubes, and long enough to go two and a half times round the abdomen, must be in readiness. Each end is to be torn into four or five tails. The middle of the flannel is then to be applied to the front of the abdomen, and the tails so arranged as to interdigitate with each other opposite the spine. By pulling on the tails on each side a uniform elastic pressure is maintained over the abdomen during the operation, which facilitates the flow of the fluid, and diminishes the tendency to fainting. A circular hole is cut in the flannel at the point at which the puncture is to be made. The patient must be brought to the edge of the bed, and placed in the recumbent position, with the head low. If the quantity of fluid is not great, and the small intestines float up so as to come in contact with the lower part of the abdominal wall, it may be necessary to raise the patient into a semi-recumbent position, in which the intestines will float to the epigastric region. Having put the patient in position, the operator must himself percuss the abdomen between the pubes and the umbilicus immediately before inserting the trochar, and he will, of course, not proceed with the operation unless there is absolute dulness. Having ascertained that everything is in proper order, the skin is drawn a little to one side, and the trochar is plunged sharply through the abdominal walls in the linea alba, at a point midway between the umbilicus and pubes. Other points have been recommended, as the linea semilunaris, but the middle line is now universally preferred. As soon as the trochar is withdrawn, the assistants pull firmly on the tails of the bandage, and continue to do so as long as any fluid flows. As soon as the fluid ceases to flow, the cannula is withdrawn, and a piece of lint, soaked in collodion, is applied over the puncture. The corresponding tails of the flannel bandage are then firmly tied together over the middle line of the abdomen. For ordinary cases the aspirator is in every way inferior to the syphon trochar, and should never be used. If the patient should become faint during the operation the instrument must be withdrawn, the head put as low as possible, and some stimulant administered.

Dr. Reginald Southey has recommended a more gradual evacuation, in preference to the rapid method above described. He employs a very fine cannula, perforated laterally by numerous openings, and provided with a bulb-head and a shield. To the bulb-head is attached a long india-rubber tube. The cannula is inserted in the middle line, and fixed in position by strapping; and the fluid drains slowly away at the rate of about one pint per hour. The cannula may be allowed to remain in position, if necessary, for about twelve to twenty-four hours. Dr. Southey claims for his method the following advantages—simplicity; freedom from pain; absence of any tendency to syncope; and the avoidance of the necessity for bandaging afterwards. Experience has shown that there is no risk of peritonitis.

2. **Paracentesis Thoracis.**—Synon.: Thoracentesis.—This is required for serous fluid or pus in the pleura, and more rarely for blood or air. Aspiration should always be preferred to the operation by the cannula and trochar (*see* Aspirator). Should the aspirator not be at hand, the syphon-trochar should be used; or, failing that, one of the plans before mentioned must be adopted to prevent the entrance of air during inspiration. The patient must be brought to the edge of the bed, and placed in a semi-recumbent position, well supported by pillows. The spot selected for puncture varies greatly. It is generally agreed that the trochar should never be introduced below the tenth rib on the left side and the ninth on the right, for fear of wounding the diaphragm. The point most commonly chosen is above the sixth or seventh rib, between the digitations of the serratus magnus, which can usually be clearly seen. Should they not be visible, any point may be taken in the proper intercostal space between the mid-axillary line and the junction of the posterior and middle thirds of the lateral aspect of the chest. The trochar must always be kept close to the upper border of the rib, in order to avoid the intercostal nerve and artery. In whatever space the operation may be performed the lower border of the rib below the space should first be clearly felt; the skin is then to be drawn upwards for the width of the rib, and the trochar thrust sharply in immediately above its upper border. If the instruments are in good order, and the rib can be clearly defined, no preliminary incision is necessary. If, from partial absorption of the fluid, without corresponding expansion of the lung, the ribs have fallen very closely together, it may be necessary to use a flat trochar, with a lancet-shaped head. The precautions as to faintness and the closure of the wound are the same as in paracentesis abdominis.

3. **Paracentesis Pericardii.**—This operation is now invariably performed with the aspirator, as the results of the use of the ordinary trochar have been extremely unsatisfactory. *See* Aspirator.

4. **Paracentesis Capitis.**—This operation has been occasionally performed in cases of chronic hydrocephalus, but without any very marked benefit. It is not safe to use the aspirator, as the vacuum might do unexpected damage to so soft a structure as the brain, while a small trochar may be passed through the expanded hemisphere into the ventricle without risk. The instrument used should be the smallest exploring trochar. An elastic bandage must be first applied, so as to exert a very gentle pressure on the head. The trochar is then introduced at any point where bone is wanting, except in the situations of the sinuses. The best place is at one side of the anterior fontanelle. The middle line must be avoided, not only because of the longitudinal sinus, but because in the vast majority of cases the fluid is contained in the ventricles. The quantity of fluid removed should

not exceed two ounces. The elastic pressure must be maintained after the operation, which may be repeated at intervals of four or five days.

MARCUS BECK.

**PARÆSTHESIA** (*παρὰ*, a prefix indicating irregularity, and *αἴσθησις*, sensation).—A term applied to abnormal sensations experienced by a patient, distinct from mere excess or diminution of feeling; for example, tingling, itching, and formication. *See* SENSATION, Disorders of.

**PARALYSIS** (*παρὰ*, beside, and *λύω*, I loosen or relax).—SYNON.: Palsy; Paresis (incomplete paralysis); Fr. *Paralysie*; Ger. *Lähmung*.

DEFINITION.—Loss of the power of voluntarily exciting the contraction of one or more muscles, is the essential condition met with in all forms of motor paralysis. And similarly, a loss of the possibility of transmitting impressions, either of the special senses or of common sensibility from various parts of the body, from their seats of peripheric commencement inwards to those portions of the brain which are concerned with their realisation in consciousness, is what is commonly known as 'sensory paralysis.' These latter defects are, however, considered under the head of SENSATION, Disorders of. Here attention will be confined to the subject of motor paralysis, to which, indeed, the term paralysis ought to be limited. It is more fitting to speak of loss of sensation than of paralysis of sensation.

**Paralysis Motor.**—Motor paralysis may, in different cases, be occasioned by defects in various parts of the neuro-muscular apparatus. Certain primary differences of kind have first to be considered.

(*A*) Certain muscles may not contract because their customary neural incitations are impeded or abortive at their source in the cerebral cortex —as in certain forms of hysterical paralysis, or as a result of definite lesions in some portions of the brain-region above mentioned.

(*B*) Other forms of paralysis result because voluntary motor incitations are impeded in transmission during some part of their course through the nerve-centres, but below the cortical stratum of grey matter in which they take origin. Under this head are to be included by far the larger number of cases of paralysis actually met with; and according as the situation varies in which the impediment to the transmission of motor stimuli exists, so do we get the paralysis occurring in different forms, that is, affecting different distinctive groups of muscles, with or without certain characteristic associations, in the shape of sensory paralysis or disturbance, alterations in the temperature of the skin over the parts affected, and, after a time, alterations in the nutrition of the muscles whose functions are in abeyance. These very numerous forms of paralysis fall into different classes, according as the disease or injury preventing the proper transmission of motor stimuli occurs (1) in some portions of their cerebral path; (2) in some portions of their spinal path; or (3) in their passage through some of the peripheral nerves—that is, in any part of their passage to the muscles outside the medulla or spinal cord.

(*C*) Lastly, though voluntary motor incitations may be normally generated, and properly transmitted through the nerve-centres and along the peripheral nerves, an incomplete paralysis of certain muscles may still result if such stimuli, owing to degenerative atrophy in the muscles, are incapable of evoking their contraction. In these, as in the other cases, the resulting loss of movement (akinesis) would represent a true paralysis. The fact that such forms of paralysis are often incomplete, is dependent upon the peculiarity that some healthy muscular fibres usually remain in muscles which are the seat of atrophic changes (*see* PROGRESSIVE MUSCULAR ATROPHY). Whilst conceding the possibility or the existence of a group of diseases in which the changes in the muscles are primary, it must be said that modern researches have tended to show that in a very large majority of the cases of muscular atrophy such changes are sequential to previous minute lesions in the spinal cord or nerves. *See* PSEUDO-HYPERTROPHIC PARALYSIS.

The ÆTIOLOGY and PATHOLOGY of the various forms of paralysis will not now be further referred to, but will be discussed in the following articles. Some general remarks on this subject will be found under the heads of NERVOUS SYSTEM, Diseases of; BRAIN, Diseases of; and SPINAL CORD, Diseases of. Reference may also be made to the various special articles dealing with the pathological causes of brain-disease, and to the articles on the diseases of the different cranial and other motor nerves.

DIAGNOSIS.—The diagnosis or recognition of the cause or nature of any particular case of paralysis is always a many-sided problem. Having previously satisfied ourselves that it is a real and not a merely apparent case of paralysis (due perhaps to some arthritic disease), we have to endeavour to make out to which of the foregoing divisions or subdivisions the instance before us happens to belong. Paralysis of any group of muscles (in the limbs or elsewhere, and howsoever occasioned) may, of course, be either complete or incomplete; and it may be as well here to add, that it is the incomplete forms of paralysis in the limbs (cases of '*paresis*' as they are often termed) which are most apt to be confounded with certain weaknesses or motor defects due to joint-disease.

In actual practice the *primary* question as to the nature of the paralysis may be, and commonly is, somewhat simplified, inasmuch as the varieties included under class A may be well merged in the first instance with the primary category of class B, just as those of class C may be included under the second and third categories of class B. Thus the recognition of the varieties of paralysis included under classes A and C, belong to the secondary or more special problems connected with diagnosis. The so-called 'hysterical' forms of paralysis, for instance, are to be regarded as due to functional perversion rather than to actual structural damage in certain portions of the nervous system; it seems, evident, however, that in the first place we should decide whether we have to do with a disease of the brain or of the spinal cord, before taking up the secondary question as to such disease being of the merely functional or of structural type.

Thus, for practical purposes the several kinds

of paralysis are primarily divisible into three distinct categories, based upon the situation of the damage, lesion, or defective activity by which they are occasioned. We have:—

1. *Paralyses of Encephalic Origin;*
2. *Paralyses of Spinal Origin;*
3. *Paralyses of Peripheric Origin;*

according as the cause is one which operates upon or within some part of the great centres within the cranium; upon or within some part of the spinal cord; or upon or within some one or more of the nerve-trunks, in parts situated either inside or outside the cranium or the spinal canal.

It will easily be understood that each of these primary groups of paralysis, and especially the first, includes very many varieties, and that the recognition of these several varieties is often a matter of extreme difficulty—only to be achieved after an attentive and minute study of all the details of a case by those who are well instructed as to the anatomy and physiology of the nervous system, and most familiar by daily practice with the estimation of the import of the various signs and symptoms in the light supplied by this knowledge.

The primary diagnosis should, however, in the great majority of cases, be capable of being made by the practitioner with comparative certainty. In so doing he will be guided by the general agreement as to signs and symptoms presented by the case before him with one or other of the following *combinations* of signs and symptoms.

1. **Paralyses of Encephalic Origin.**—These may or may not be ushered in by an apoplectic attack, or by an epileptiform fit, or a series of them. The paralysis is usually confined to one half of the body, though only certain parts of this are affected, namely, more or less of one half of the face, with the arm and the leg (either incompletely or completely) on the same side, whilst the muscles of the trunk are comparatively little affected. Where the paralysis is incomplete, the arm is commonly more affected than the leg. Except where loss or impairment of consciousness still exists, or where both sides of the brain are affected, the patient almost invariably retains control over the bladder and rectum. The common sensibility of the same half of the body may for a shorter or longer period from the commencement of the disease be more or less diminished. The electrical irritability of the paralysed muscles is not notably altered. The superficial reflexes may be diminished, and the deep reflexes may be exalted on the paralysed side of the body. *See* Spinal Cord, Diseases of.

These are the general characters of a form of paralysis commonly known as *Hemiplegia.* It is met with almost as frequently on the one as on the other side of the body, and may occasionally affect both sides simultaneously.

2. **Paralyses of Spinal Origin.**— These forms of paralysis usually commence without convulsions or impairment of consciousness, though, like those of the last category, they may be either sudden or gradual in their mode of onset. They are, however, commonly characterised by their implication, to a variable extent, of both sides of the body. In the great majority of cases the lower extremities, either alone or with the trunk-muscles up to a certain level of nerve-supply, are the parts that are paralysed. The arms are much less frequently affected. It is common for control over the bladder and rectum (one or both) to be more or less lost. The motor paralysis may exist with little or no impairment of sensibility; though in some cases sensation, in one or other of its modes, is defective in the paralysed parts. The upper limit of defective or altered sensibility is often marked round the trunk by a sense of constriction, or a feeling as if a band were tied round the body ('girdle sensation'). The electric irritability of the paralysed muscles may be either little altered, or it may, especially in some parts, be modified in the manner to be described in the next section as characteristic of the 'reaction of degeneration'—and in this latter case early and marked atrophy of such paralysed muscles may be looked for.

These are forms of paralysis commonly known by the name of *Paraplegia.* Both sides of the body are usually affected—equally or unequally—because of the frequency with which the lesion, or cause of the disease, involves both halves of the spinal cord. Where this is not the case, however, and the injury or lesion is confined to one half of the cord, in one or other region, a condition known as *Hemiparaplegia* results, in which, in addition to other special characters, there is an absence of any trace of facial paralysis, even though the arm and leg on one side of the body (where the lesion exists high up in the cervical region of the cord) may be implicated in much the same manner as they are in hemiplegia. Here, however, the paralysis of motion occurs on the same side as the lesion.

3. **Paralyses of Peripheric Origin.**—The majority of paralyses resulting from disease or injury of nerve-trunks are rendered comparatively easy of recognition by the fact that the loss of power is in each case limited to the muscles supplied by particular nerves. This circumscribed nature of the paralysis is a fact of great value for diagnostic purposes—especially when the loss of power is complete rather than partial, because it is in these cases more particularly that we are apt to get another characteristic sign of peripheral paralysis, namely, an altered electrical excitability of both nerve and muscles. Where the injury to or disease of a nerve-trunk is well-marked, so that its fibres are either severed or rendered incapable of conducting stimuli from the centres, owing to pressure or other causes, it is found that within a period of six to fourteen days the following electrical phenomena may be detected:—Loss of irritability of the affected nerve-trunk to both electric currents; loss of or greatly diminished irritability of the affected muscles under stimulation by the Faradic current, together with an increase of their sensitiveness to the Voltaic or continuous current—so that they respond to the latter even more readily than the corresponding muscles of the opposite side. These characteristics, as a whole, together with certain minor peculiarities, constitute the so-called 'reaction of degeneration' (*see* Electricity). To these characters must be added the further peculiarity that the muscles thus affected are apt speedily (within two or three weeks from the onset of the paralysis)

to show a marked amount of atrophy—a change easily to be appreciated in limb-muscles, and in some of those pertaining to the trunk, but by no means so obvious in the muscles of the face.

The above constitute the characters which are in the main to be relied on for the diagnosis of paralyses of peripheric origin. Still it must not be forgotten that when the ganglion-cells in the medulla or spinal cord, which constitute the nerve-nuclei of the several motor nerves, are diseased, we may have almost precisely the same effects produced as if the nerve-trunks had been damaged in some part of their course—that is, we may have in each case the electrical 'reaction of degeneration' followed by speedy atrophy of the affected muscles. In this case, indeed where we have disease of an atrophic character limited to the nerve-cells composing the nucleus of a motor nerve or nerves, we should have a form of paralysis, tolerably well typified by 'labio-glosso-laryngeal paralysis,' which might almost with indifference be placed either in the category of spinal or of peripheric nervous diseases. They would be, it is true, spinal in seat; and yet they would be attended by all the clinical characters pertaining to disease of the nerve-trunks—and this naturally enough, seeing that the disease would in fact simply affect the proximal extremities of nerve-trunks.

What has just been said will serve to explain how it is that in many cases of paralysis of spinal origin, that is, due to large 'transverse' lesions, seriously damaging the grey matter of the cord, we may get, together with the wide or general distribution of such a paralysis, evidence that *in some* of the muscles the electrical 'reaction of degeneration' may be detected as well as early wasting. These characteristics of peripheral paralysis will, in fact, occur in muscles where the grey matter at the roots of their nerves has been destroyed. In cases of paraplegia due to large transverse lesions limited to the cervical or to the upper dorsal region, we might, therefore, look for and find the 'reaction of degeneration,' with early wasting in some of the muscles of the upper extremities or of the trunk, whilst we should not find these characters, nor be warranted in looking for them, in the muscles of the equally paralysed lower extremities.

Of course, in most cases of paralysis, the patient's personal and family history, as well as the mode of onset of the disease, will help to throw light upon the question whether, in the case before us, we have to do with a paralysis of encephalic, of spinal, or of peripheric origin.

The further characters of paralyses of spinal origin (paraplegias and hemiparaplegias) will be found in the article Spinal Cord, Diseases of; whilst those of the paralyses of peripheric origin will be found in the various articles on diseases of special motor nerves, such as the facial, the sciatic, &c. Diphtheritic paralysis is also an obscure affection commonly supposed to pertain to this class. *See* Paralysis, Diphtheritic.

But the type of those diseases included under the head of *Paralyses of Encephalic Origin* will now be more particularly described.

This account of the characters pertaining to an ordinary form of **Hemiplegia** can perhaps best be given by detailing the combination of signs and symptoms produced by disease, either in the form of hæmorrhage or of softening, in one of the corpora striata. We may suppose such disease to be situated on the right side of the brain, and then, as a consequence, we should meet with a left hemiplegia.

*Characters of left hemiplegia from disease in or near the right corpus striatum.*—Where there is a sudden onset of the disease and a large lesion, such as may occur especially in some instances of hæmorrhage, the symptoms may be ushered in by an apoplectic attack, and a condition of unconsciousness may remain, as a result of general brain-shock, for minutes, hours, or even days. Convulsions rarely occur in such a case. Where the hæmorrhage is slighter in amount, or where the causes of softening, in the form of vascular obstruction, are limited in seat and not abruptly brought about, there may be no loss of consciousness whatever at the onset, nor any sensation referred to the head. The patient may perhaps experience a mere momentary vertigo; and sensations of numbness or tingling rather than of actual pain may be felt for a minute or two in one or other, or perhaps in both limbs, before their weakness or actual paralysis is detected.

In a case of this kind, or after recovery of consciousness in the more severe form of the disease, the patient will on examination be found to present the following characteristics:—(1) An absence of any decided mental disturbance; (2) slight 'thickness' of speech; (3) more or less deviation of the tip of the tongue towards the paralysed side, when it is protruded; (4) partial and incomplete paralysis of the facial muscles on the side on which the paralysis of the limbs exists—the angle of the mouth is lower, and the naso-labial fold less distinct than on the opposite side, though the two eyes can be closed almost equally well; (5) more or less complete loss of voluntary power over the left arm and leg; (6) a flaccid state of the muscles of these limbs, which are found to respond naturally, or perhaps even a little too readily, both to the Faradic and Voltaic currents; (7) some slight loss of sensibility, as well as a feeling of numbness, on the paralysed half of the body; (8) slight elevation of temperature on the paralysed as compared with the non-paralysed side of the body—the difference being seldom more than one degree of the Fahrenheit scale.

Of these signs, the thickness of speech, the deviation of the tongue, the paralysis of the face, and the diminished sensibility, soon either grow perceptibly less or actually disappear. In the slighter cases, after some days or a week or two, there may also be some return of voluntary power over the leg and the arm; but in the more severe forms of complete hemiplegia, not proving fatal, any recovery of motor power in the limbs may be delayed for months instead of weeks, and then perhaps the recovery may be only very slight. In all cases, however, the recovery of power usually begins to show itself in the leg sooner than in the arm; and the muscles about the joints nearer the body are in each case capable of being called into action before those

moving joints which are more remote. Sometimes in the early stages of the disease some amount of rigidity may be met with in the arm or in the leg, or in both simultaneously, which is found to disappear during sleep—'early rigidity'; whilst later on a more permanent form of rigidity associated with organic changes in the muscles and tendons—'late rigidity'—is apt to supervene. See the writer's *Paralysis from Brain-disease*, pp. 151–178.

The particular combinations of symptoms met with in different cases of hemiplegia vary in an almost endless manner, as the situation of the brain-lesion varies, and also to a less marked extent in accordance with variations in its magnitude, and in the suddenness with which it is brought about. Thus, in regard to variations in the extent and completeness of motor paralysis alone, we may have merely a slight facial paralysis, with some weakness of the arm on the same side, and none of the leg; or the paralysis of arm and face may be more marked, together with slight paralysis of the leg; or paralysis may be pretty complete in all three situations. More rarely the leg may be more completely paralysed than the arm; and where lesions exist in both hemispheres of the brain, or in the pons Varolii, a double hemiplegic condition may exist—either complete or incomplete, and in the latter case probably unequal in degree on the two sides of the body. Similar variations exist in regard to many of the other concomitants of the hemiplegic state; for example, as regards the amount of mental disturbance, the kind and degree of impairment of speech, the amount of paralysis of tongue and difficulty of deglutition, the amount of paralysis of the face and of implication of the ocular muscles, the amount of impairment of common sensibility and of the special senses, the amount of difference in temperature between the two sides of the body, and the amount of command over the sphincters of the bladder and rectum. Combined in different groups, owing to the different relative development of these or those particular symptoms, we get all the different grades and kinds of hemiplegia actually met with in practice.

The attempt to connect this difference in grouping of the signs and symptoms with differences in the locality of the lesion, is to concern ourselves with the *secondary*, as opposed to what has been previously termed the *primary*, problem of diagnosis. We should then have to consider what is more especially termed *regional diagnosis*, which, however, can only be attempted after careful study has been given to the several distinctive effects produced by disease in the different regions and parts of the encephalon.

In attempting to arrive at a *pathological diagnosis* in any case of paralysis, our attention must be given more to the mode of onset of the affection, and to the state of other organs and parts of the body, than to the signs and symptoms of the established disease, though we are compelled to rely most upon these latter for the establishment of a regional diagnosis. Still these two sides to the problem of diagnosis are often very intimately related to one another, so that it may be essential to consider them concurrently in order to derive from each side of the problem all the light that may be possible for the elucidation or confirmation of the other half of it.

The questions concerning PROGNOSIS and TREATMENT are considered separately under the head of the special forms of paralysis, and of the diseases giving rise to the different kinds of paralysis of encephalic, of spinal, and of peripheric origin. H. CHARLTON BASTIAN.

**PARALYSIS AGITANS.**—SYNON.: Shaking Palsy; Fr. *Paralysie tremblante*; Ger. *Schüttellähmung*.

DEFINITION.—A disease of advanced life; progressive in its course; and characterised mainly by tremors of the limbs occurring independently of muscular exertion, rigidity of muscles, and a tendency in walking to loss of equilibrium.

ÆTIOLOGY.—The causes of paralysis agitans are obscure. It is rarely met with prior to forty years of age, but becomes more and more frequent as life advances. It affects both sexes, but men probably more frequently than women. There is little reason to regard it as hereditary. It has been attributed to violent emotion, to excessive bodily fatigue, and to exposure to cold and wet. It has also been referred to wounds or injuries involving nerves. In many cases no cause is assigned or can be discovered.

ANATOMICAL CHARACTERS.—The disease, no doubt, is one of the nervous centres. But no distinctive lesion has yet been discovered in these parts. Sclerotic and other degenerative changes, evidences of sanguineous exudations in the course of some of the smaller vessels, diseased arteries, and various coarse lesions, have not infrequently been met with in the cord and brain; but the morbid changes hitherto observed have been variable in seat and character, and such only as are frequently present under other circumstances in persons who die in old age.

SYMPTOMS.—Paralysis agitans, with few exceptions, comes on insidiously. The patient is first attacked with occasional tremors in a hand, a thumb, or a foot. These attacks come on irregularly, without obvious cause, and last for an uncertain period. But gradually they increase in frequency, duration, and severity, and spread from the part first involved, until, at length, probably all the limbs become implicated. In most cases the tremors, commencing in a hand or foot, by slow degrees invade the rest of the limb, and thence spread in hemiplegic fashion to the other limb of the same side. Less commonly the affection spreads in the first instance from one leg to the other. And very rarely do both arms suffer, the legs remaining free, or does the affection involve the limbs diagonally. Associated with the tremors, sometimes preceding them, but much more frequently coming on at a later period of the disease, there may always be observed a peculiar rigidity of the muscles. This is often attended with cramp-like pains, and, like the tremors, is liable at first to more or less obvious and prolonged intermissions. It implicates the muscles of the head and neck and trunk, as well as those of the extremities, and the flexor muscles in greater degree than their opponents. Another remarkable characteristic of the disease, always developed

sooner or later, is an inability to maintain equilibrium when walking is attempted.

When the disease is fully developed, and the several phenomena above enumerated are associated, the collective symptoms produce a very remarkable and characteristic picture. The tremors involve the arms and legs; the head and neck remaining, as a rule, absolutely free from them. They consist of fine and rapid oscillations, which are more or less constant, but liable to exacerbations; cease during sleep; can occasionally be arrested temporarily by voluntary effort; and often occur with exceptional violence when the patient is otherwise at absolute rest. The movements of the hands are peculiar. The thumbs are usually extended, and the fingers flexed upon them; and collectively they move as though the patient were rolling a pencil or crumbling bread. The oscillations, however, are not limited to the hands, but involve the wrists and other joints of the upper extremities. The tremors of the lower limbs, especially when the patient stands, are necessarily transmitted to the rest of the body. The rigidity, which affects in a greater or less degree all the muscles, imparts a striking character to his attitude and aspect. It causes the arms to stand out slightly from the trunk; the elbow- and wrist-joints to be slightly flexed; the hands to be tilted towards the ulnar side, and to rest in front of the abdomen at or near the waist; and the fingers to be flexed or distorted at their several joints. It causes the trunk to incline forwards, as the patient stands or walks; the knees to be slightly bent; and the feet to be extended at the ankles; so that he rests upon his toes. But, above all, it causes the head and neck to be thrown forwards, and to be retained rigidly in that position, and the features to be immobile and inexpressive. This peculiar fixity of the head and neck and face, associated as it is with constant tremors in the limbs, constitutes a very striking feature of the disease. The difficulty of maintaining equilibrium, though no doubt increased largely by the presence of muscular tremors and rigidity, is not wholly due to them, for it may be well developed at a very early stage of the disease. Moreover, it may be long delayed. When thus affected the patient has some difficulty in rising from his seat, and, before he starts off walking, probably hesitates a little, as though for the purpose of balancing himself. Then, with his body bent forwards, he begins to walk, perhaps with some care, but soon his steps become rapid and short, and he runs forwards in spite of himself, and if not arrested probably falls. Sometimes the tendency of the patient is to run backwards, even though the body incline forwards. Often in these cases, while the patient is being propelled forwards apparently in spite of himself, a sudden pluck at his clothes will reverse or alter the direction of his accelerating movement. These phenomena are not attended with vertigo.

Other symptoms less striking than the above, but of more or less importance, are usually present in shaking palsy. There is generally, even from the first, a great sense of weariness in the affected muscles, especially after exertion or an attack of tremors; but, contrary to what might be supposed, the tremulous and rigid muscles are, as a rule, markedly stronger than their as yet unaffected fellows. The patient, more particularly late in the disease, becomes excessively irritable and fidgety, so that at night especially he finds it difficult or impossible to place himself in a comfortable position; he is apt also to suffer from a painful sense of heat, mainly referred to the epigastrium and back. Speech generally becomes markedly affected, not from loss of language, but from difficulty of enunciation. Words are uttered slowly, and with manifest effort. Associated with this there is often tremulousness of the tongue. But the slowness and difficulty of utterance, which are often associated with slowness and difficulty of deglutition, constitute only one manifestation of the general slowness and difficulty of movement which, for the most part, characterise the disease. Sensation is not impaired; and the patient retains his mental faculties, and control over the rectum and bladder.

Diagnosis.—The affections with which paralysis agitans are most likely to be confounded are disseminated sclerosis, and mercurial tremors. But in the former of these the tremors occur only when the muscles are in use, and for the most part involve the head; the limbs early become paralysed; the patient has no tendency to run forwards or backwards; and generally nystagmus is present. In the latter affection there is probably a history of exposure to the fumes of mercury, and a blue line on the gums; the tremors involve not only the limbs, but the head and neck, and are symmetrical; and there is an absence of the peculiar gait of paralysis agitans.

Progress and Terminations.—The disease is one of slow and often irregular progress, and usually lasts for many years; indeed it may be many years before it attains its full development. In rare cases it is recovered from in the early stage; but for the most part it is incurable. In its last stage the patient becomes confined to his couch or bed; the muscles waste; the tremors, though generally extreme at the time, occasionally cease; the mental powers fail; bed-sores form; and general prostration ensues. Death is due either to asthenia, or to some intercurrent disorder, more especially pneumonia.

Treatment.—In treating shaking palsy it is of importance to give careful attention to all hygienic measures, and to promote the patient's health, if need be, by tonics. Specific treatment has proved of little or no service. Nervine tonics and sedatives have been largely employed; but those which have found most favour probably are iron, strychnia, and hyoscyamus. The systematic use of baths has occasionally proved of temporary benefit. The persistent application of the continuous galvanic current seems to have been serviceable in some cases.

J. S. Bristowe.

**PARALYSIS, Diphtheritic.** — Synon.: Fr. *Paralysie diphthéritique*; Ger. *Diphtheritische Lähmung*.—Paralytic affections are so frequently associated with diphtheria, that they have been generally, though perhaps not correctly, regarded as peculiar in their origin, and as constituting a characteristic part of the disease. This question

is too extensive for discussion here. Still it is necessary to call attention to the fact that paralysis, in various forms and degrees, occurs associated with, or as a sequel of, typhoid fever, relapsing fever, cholera, dysentery, small-pox, and pneumonia; and that in all, they are attributed by Gubler and others to an essentially similar state incident to most fevers and acute diseases. Though their course and phenomena present points of difference, they have common fundamental characteristics—namely, they seem all to be, as a rule, of peripheral origin; they all manifest a natural tendency to recovery; and when they become protracted, they are apt to become permanent from atrophy of the muscles caused by long disuse.

Symptoms.—The usual period of the first manifestations of diphtheritic paralysis is from eight to twelve days after an apparently complete recovery. To this rule, however, there are exceptions. Sometimes, the paralytic affections do not occur till the patient has seemed to be well for more than a month; and, on the other hand, they sometimes show themselves during the acute stages of the disease, as early, occasionally, as the second or third day from its explosion. When they do not occur till the close of the convalescence, or till an interval of some days or longer after apparent recovery, they are usually much more severe, more protracted, and more generalised. When they show themselves in the course of the acute malady, they are generally slight, transitory, and limited, being then confined for the most part to the veil of the palate, the pharynx, and œsophagus. In many cases, the veil of the palate is alone affected

Generally, the earliest indication of a paralytic affection is a slight difficulty in swallowing liquids. Sometimes, the paralysis announces itself by a choking cough on attempting to eat. The cause of the cough—sometimes an alarming and dangerous symptom—is the food coming in contact with the mucous membrane of the upper part of the larynx, in consequence of the paralysed state of the veil of the palate. This organ is insensible, as may readily be proved by the failure to excite reflex action by touching it. A striking feature usually appears in the changed character of the voice—its whispering nasality. The eyelids droop or remain half-closed; the muscles of the face become affected; the cheeks are expressionless and flabby; and the powerless, flaccid lips allow the saliva to dribble from the mouth, giving the patient an idiotic aspect, which is frequently intensified by the muscles of the neck losing the faculty of supporting the head. The speech of diphtheritic patients is variously affected: it is often more or less slow, difficult, thick, and stammering—manifestations due to different degrees and different combinations of paralysis of the veil of the palate, pharynx, tongue, lips, and cheeks. The inferior extremities are generally paralysed before the superior; but when the former become affected the latter seldom escape. In rare cases the paralysis begins in the arms. More serious aggravations of the situation may be added; or they may arise before the limbs have become affected. The heart, the muscles of the chest, and the diaphragm may one or all be stricken, gradually or suddenly, by loss of power. Paralysis of the heart is a cause of patients dying suddenly from cardiac syncope, when no immediate danger has been apprehended. Sometimes this cause of death is threatened before it occurs. When the respiratory muscles are affected, even in a moderate degree, the condition is one of danger, in consequence of the lungs becoming congested from imperfect expansion of the thoracic parietes. The intestinal canal and the bladder are often paralysed. There may be constipation as inveterate and painful as that of lead colic; there may be obstinate constipation without pain; or the fæces may be passed involuntarily, with or without medicinal interference. The bladder, though at first only moderately sluggish, will probably soon become absolutely paralysed from over-distension, the existence of the paralysis being shown by a constant dribbling from the urethra. The intestinal canal and bladder—one or both—may be distressingly stricken when other paralytic affections are almost or altogether absent. Recorded cases show that all the senses are liable to be affected. The sense of sight is that, however, which is by far the most frequently implicated. Squinting, imperfect sight, and other visual disturbances arise from a loss of co-ordinative muscular power, paralysis of particular muscles, dilatation of the pupils, and insensibility of the retina—from these causes separately, or in various combinations. Amblyopia, presbyopia, myopia, and diplopia may be met with; but the first is the most common. Local or general cutaneous anæsthesia is usually associated with diphtheritic paralysis. In cases in which the diphtheritic pellicle has never appeared in the throat, paralytic affections may be met with. Sanné states that he has seen paralytic affections in a child in which the false-membrane existed only on the skin around the navel, and also in another in which it was limited to one ear. Similar exceptional cases have been observed by others.

Course.—There is in all cases of diphtheritic paralysis a strong natural tendency to recovery. Under certain special reservations, therefore, such as extreme debility, or implication of the heart, respiratory muscles, or larynx, the prognosis is favourable. The duration of the paralytic affections is very variable, and is dependent to a considerable extent upon the manner in which the function of nutrition is performed, and the skill and vigilance with which nature is assisted by treatment. The duration is much more frequently weeks than months; and when it is more than a year, there is a great probability of the affection becoming permanent, from the establishment of one or more secondary conditions, such as atrophy of muscles, and the ascent of the morbid state from the periphery to the nervous centres.

Pathology.—There is no proof that there is a specific cause of paralysis in diphtheria. During the course of, and in the convalescence from no other acute disease are asthenia and anæmia so constant and so profound as in diphtheria; and in no other disease is paralysis so frequent. The two facts probably stand to each other in the relation of cause and effect, The treatment for asthenia and anæmia is the treatment for diphtheritic paralysis. The affection extends

from the peripheries of the nerves upwards. When the nervous centres are implicated, their implication is secondary.

TREATMENT.—In principle and in detail, the treatment of the paralysis of diphtheria is to a great extent a continuation or renewal of the treatment of convalescence from the attack of the disease itself. Every available means must be employed to promote nutrition, and the healthful exercise of all the functions. The leading therapeutical indications, in respect to general treatment, are fulfilled by giving the patient a pepsinated diet, a ferruginous medication, and as much of the open air as weather and the circumstances of the case permit. The dietetic and medicinal details must be carefully regulated and modified, in accordance with the progress of the patient, and the personal peculiarities of his case.

Orezza water is a good form in which to administer iron in these affections. When the patient has a repugnance to take this water with his meals, in doses of from an ounce to six ounces, it may be given half an hour or an hour after he has eaten. Artificial preparations of iron may also be used with advantage, such as the liquor ferri perchloridi, in doses of from five to thirty minims in water twice or thrice a day. The carbonate of iron pill, in doses of from three to ten grains twice or thrice a day, immediately before or with meals, often answers remarkably well. Bitter effervescing iron-draughts suit some patients.

When amendment is slow or absent under the use of ordinary doses of iron, though the anæmic condition of the patient seems strongly to proclaim the necessity of this medicine being given, its use must not be hastily abandoned, but it should be administered in very small quantity, and largely diluted. Should we still be disappointed with the result, it will be well to try iron in combination with iodine or with arsenic in suitable forms.

The extract of nux vomica, or the liquor strychniæ, in small doses taken daily with some ordinary combination of laxatives in pills, should constitute part of the later treatment in nearly every case.

In addition to the general treatment, the paralysis of diphtheria frequently calls for other measures of a special character.

Persistent and carefully regulated local stimulation may be required to restore impaired innervation, and to secure an adequate supply of arterial blood to the wasting muscles. There are no other means so likely to arrest and prevent degeneration and atrophy of the muscles—morbid changes, which, if unchecked, lead inevitably to the permanence and incurability of the paralysis. Local stimulation may be accomplished by blisters, liniments, pastes, or shampooing. One or other of these means may be employed either separately, or in conjunction with some of the others. The occasional application of blisters is most useful; but care must be taken not to vesicate too large a continuous surface, so as to interrupt the use of systematic gentler stimulation by liniments, pastes, and shampooing. Care must also be taken not to make the skin too tender to admit of the muscles being exercised from time to time without pain. To limit the blister to the surface intended, securing at the same time rapid and comparatively painless vesication, the best proceeding is to paint the surface which it is desired to vesicate with an acetum cantharidis four times as strong as the acetum of the British Pharmacopœia. The liquor epispasticus is an excellent application for raising an immediate blister; but when time is not all-important, it is better to use a strong acetum cantharidis. Lubrication with liniments combining anodyne with stimulating properties is particularly suitable, in conjunction with shampooing, and the galvanic excitement of contraction of the paralysed muscles. A good application of this description is composed of one part of tincture of cantharides, one part of tincture of opium, and six parts of compound camphor liniment. A good stimulating paste is composed of six drachms of powdered ginger, and two drachms of English mustard, thoroughly rubbed up with just a sufficient quantity of lard to make a paste of suitable consistence. Circular bands of linen, an inch in breadth, smeared with this stimulating paste, are applied at intervals of five or six inches to the whole length of a limb, care being taken to change the position of the bands once, twice, or oftener, in the twenty-four hours, so that, whilst the surface is kept glowing with warmth by the paste, its topical action on the skin is not allowed to exceed the proper limit. When the warm tingling sensations caused by the stimulating bands induce restlessness and prevent sleep, the bands must be removed for eight or ten hours at a time. In paralysis of the respiratory muscles, large sinapisms applied to the chest are of much use. In cardiac paralysis, Duchenne has recommended faradisation of the præcordial region. Galvanic excitement of contraction in the paralysed muscles of the limbs is often decidedly useful; but it is a measure which requires to be employed with moderation, and at intervals of about twenty-four hours. If resorted to too early, or too freely, it exhausts the returning power of the affected muscles.

When the paralytic affections become general, or the improvement is imperceptible or very slow, sea-air, sea-baths, and hydrotherapeutics deserve attention. In obstinate and protracted cases—particularly in strumous subjects—they often prove of much advantage when employed together with, or apart from, other measures.

JOHN ROSE CORMACK.

**PARALYSIS, SENSORY.** *See* SENSATION, Disorders of.

**PARAMENIA** (παρὰ, irregularly, and μὴν, a month).—A term for irregular menses. *See* MENSTRUATION, Disorders of.

**PARAPHIMOSIS** (παρὰ, beside, and φιμόω, I confine).—SYNON: Fr. and Ger. *Paraphimosis.* A morbid condition of the penis, in which the prepuce having been drawn or forced back behind the glans, cannot be returned, and thus gives rise to a condition of strangulation of the parts in front of it. *See* PENIS, Diseases of.

**PARAPLEGIA** (παρὰ, incompletely, and πλήσσω, I strike).—Paralysis of the lower extremities, usually associated with paralysis of the lower part of the trunk, bladder, and rectum. *See* PARALYSIS; and SPINAL CORD, Diseases of.

**PARASITES** (παρὰ, upon, and σιτέω, I feed). Synon.: Fr. *Parasite*; Ger. *Parasit.*

Definition.—This term, in its most extended sense, is applied, in general pathology, to those living organisms which derive their nourishment wholly or in part from other living organisms. Parasites may be vegetable or animal—*phyto-parasites* or *zoo-parasites*; may live upon the surface of, or in the textures or cavities of, the organisms they infest—*ecto-parasites* or *ento-parasites*; and may pass through the whole cycle of their existence in the parasitic state, or only during certain stages of their life.

This definition will include those organisms, such as tinea and trichina, which feed upon the living tissues of the hosts they infest; those which subsist on the material prepared by the host for its own nourishment—for instance, torula and tænia; and, lastly, those which only temporarily sojourn on the surface of the body, for the purpose of obtaining food, and do not live, for any period of their existence, upon or within their entertainer—for example, fleas and gnats.

The majority of these parasites may be regarded as direct causes of disease, the pathology of which is now being made the subject of accurate investigation, and will be found described, so far as is known, in other parts of this work. A few only of the fungi, such as the blue moulds (penicillium glaucum), may be looked upon as a result of a morbid condition, being occasionally met with on the surface of old ulcers, in old cavities of the lungs, and on the nails.

Vegetable parasites and animal parasites will be separately noticed in the following articles.

**PARASITES, Vegetable.**—Vegetable parasites are included under the general term of *fungi*. More accurately they are to be referred to the classes Schizophyta or Protophyta, and Zygosporeæ, which are provisionally the lowest divisions of the sub-kingdom Thallophyta.

To the order Schizomycetes of the former class belong Micrococcus, Bacterium, Bacillus, Vibrio, Spirillum, &c.; and to the order Saccharomycetes of the same class, the various Torulæ or Mycodermata, and Sarcina ventriculi.

These organisms are extremely simple, consisting of minute particles of living matter—spherical, cylindrical, filiform, curved, straight, or spiral. They occur in swarms, which are either free, or imbedded in a gelatinous matrix—the *zooglœa-stage*. They contain no chlorophyl, and a nucleus is often wanting. They multiply by fission. The cells of the Torulæ, or yeast-plants, are frequently aggregated into simple or branching rows; and in Sarcina ventriculi the cells are arranged in groups of four, sixteen, or thirty-two, presenting a very characteristic appearance.

The numerous forms included under the term Bacteria are met with normally in many situations in the body; for example, they are an invariable accompaniment of pancreatic digestion. Pathologically, they are of frequent occurrence in the blood, urine, and other fluids, and are regarded as playing an important share in many contagious and other diseases (*see* Bacteria; Contagion; Micrococcus; and Zyme). The ferment-bodies—Torulæ and Sarcinæ—are also found in the stomach during digestion, and the former are abundant in diabetic urine.

In the class Zygosporeæ are comprised the filamentous varieties, such as Oïdium albicans, and the various parasites to which the term Tinea is applied (Trychophyton tonsurans, Achorion Schœnleinii, Microsporon furfur, &c.).

W. H. Allchin.

**PARASITES, Animal.**— A strict definition of the term *animal parasites*, in the writer's view, should be understood to include 'all those forms of creatures which in a direct manner, by dwelling in or upon other living animals, or by merely visiting or momentarily alighting on the surface of the body, are thus enabled to acquire means of subsistence.' A definition of this comprehensive character not only embraces a variety of creatures rarely spoken of as parasites, such as bugs, fleas, flies, mosquitoes, and so forth, but it appropriately excludes all those forms of animal life that merely play the *rôle* of fellow-boarders (*commensals* or messmates of Van Beneden), and which, nevertheless, are commonly looked upon as parasites. Regarded from a purely zoological point of view, the classification of the animal parasites is a matter of great difficulty; but, for all practical purposes connected with medicine and hygiene, it is sufficient to speak of the intestinal worms as forming three well-marked groups, namely:—(1) *fluke-worms*; (2) *tape-worms*, including *bladder-worms*; and (3) *round-worms*, including *thread-worms*. Under the heading Entozoa will be found a full list of the human animal parasites. For an explanation of various terms employed in connection with the study of animal parasites, the reader should consult the articles on Intestinal Worms; Helminths; Vermes; and Worms. The insect parasites (bots, maggots, &c.) are noticed under Œstrus.

T. S. Cobbold.

**PARENCHYMATOUS** (παρὰ, beside, and ἐγχέω, I pour in).—The word *parenchyma* was formerly used to designate the connective tissue of the several viscera; but it is now applied to the protoplasm, or active elements, of a tissue or organ; and morbid processes affecting the actual substance of an organ are hence called *parenchymatous*.

**PARESIS** (παρίημι, I relax).—A slight or imperfect paralysis of motion. *See* Paralysis.

**PARONYCHIA** (παρὰ, beside, and ὄνυξ, the nail). — Inflammation in close proximity to a nail. A synonym for whitlow. *See* Nails, Diseases of; and Whitlow.

**PAROTID GLANDS, Diseases of.** *See* Mumps; and Salivary Glands, Diseases of.

**PAROXYSM** (παρὰ, indicating increase, and ὀξύνω, I sharpen).—This word is used to indicate the periodic attacks or fits which characterise certain diseases, whether regular or irregular, such as ague, gout, and asthma. It is also used to designate the aggravation of certain symptoms from time to time, such as neuralgic pain, colic, and dyspnœa. Diseases characterised by these phenomena are called *paroxysmal diseases*.

**PARTIAL** (*pars*, a part).—When applied to disease this term may refer either to its extent, or its degree. Thus we speak of *partial paralysis*; and *partial blindness, deafness*, &c.

**PASSIVE.**—This epithet is used by some pathologists in connection with certain morbid conditions, such as congestion, dropsy, œdema, and hæmorrhage, where there is deficiency of vital power, either general or local, and a want of reaction or resistance in the tissues. Some pathologists employ the term *passive congestion* as synonymous with congestion from obstruction (*see* CIRCULATION, Disorders of; and HYPOSTASIS). *Passive movements* of any part, for instance, of a joint, are movements effected by some agency external to the limb, such as the hands of the practitioner or of the patient himself, in contradistinction to movements produced by the muscles of the affected parts, which are called *active movements*. *See* MOVEMENT, Therapeutical Uses of.

**PATENT FORAMEN OVALE** or **SEPTUM.** *See* HEART, Malformations of.

**PATHOGENIC** (*πάθος*, disease, and *γενάω*, I give rise to).—A term applied to the production of a disease, having reference to the mode in which the several causes which lead to it operate in its development.

**PATHOGNOMONIC** (*πάθος*, disease, and *γιγνώσκω*, I recognise).—This word is associated with those symptoms and signs which are specially characteristic of a disease, and which by their presence render its diagnosis certain. *See* DISEASE, Diagnosis of.

**PATHOLOGY** (*πάθος*, disease, and *λόγος*, a discourse).—Pathology is the name generally accepted for the science of disease, but the subjects which it may include cannot be exactly defined. For, ease and disease, well and ill, and all their synonyms are relative terms of which none can be defined unconditionally. If there could be a fixed standard of health, all deviations from it might be called diseases; but a chief characteristic of living bodies is, not fixity, but variation by self-adjustment to a wide range of varying circumstances, and among such self-adjustments it is not practicable to mark a line separating those which may reasonably be called healthy from those which may as reasonably be called disease.

The impossibility of marking such a line may be tested during changes in any external conditions of life, for instance, in the adjustments of the skin to a widely varying range of external temperatures. Where and when in the changes of skin produced by long contact with water rising from 20° Fh. to 200° Fh. would health cease and disease begin? Similarly, in the consequences of mechanical injuries. The complete repair and reproduction of injured and lost parts is an excellent instance of health; and in many plants injuries elicit a greater production of healthy structures than would occur in their integrity—as in the leaf of a Begonia or a Cardamine, in which a fresh shoot may grow from each of many wounds. But while these, and similar adjustments to conditions produced by injury, may be deemed results and signs of health, many others, such as those which may follow severe crushings and open wounds of limbs, must rather be called processes of disease, even though they may end in some repair of injury. Among all the cases intermediate between these extreme groups of adjustment to consequences of injuries, it is not possible to separate the healthy and the diseased.

In this impossibility of scientific definition the range of pathology is vaguely settled by a general understanding as to what may be called disease, and in this settlement are included all the states which are distant from health, whether they be in the way of diverging from it or in that of returning to it, as in convalescence. And some states are included for which it is hard to assign a better or other reason than that they are not useful to us. When fruits or other parts of plants or animals, which have been made useful by cultivation, revert to their more natural state and become useless, they are generally regarded as diseased.

Moreover, in the study of any disease its processes are found, though different, yet not essentially distinct or separable from those of health. Even in the instances of the widest deviations from health, as in the diseases called specific or malignant, a considerable part of the phenomena are due to processes tending towards a reversion to health, and even the changes most averse from health are limited within certain methods not wholly unlike the healthy ones.

In this view pathology may be regarded as an extension of physiology into the study of living bodies in conditions widely unlike those of their ordinary life. Pathology, herein, accepts the conventional limitation of physiology to the study of the nature of living things; but the limitation is convenient more than just. It is not possible to give a verbal definition of the difference between the study of crystals deformed or repairing after injury, and that of monstrosities and the processes of repair in plants and animals. As physiology is not truly limitable from chemistry and physics, so in pathology many processes are illustrated by things abnormal or contrary to general rule in dead matter.

Pathology finds in physiology its basis, the varying standards of healthy structure and function with which its subject-matters are in contrast, and the models and methods of its study; but its range is wider than that of physiology, inasmuch as the conditions giving rise to disease are much more numerous and more various than those of health. Moreover, the deviations from health may reach so far and wide, that the facts and general principles of physiology can only with extreme caution be applied to them. For instance, the greater part of what may be called personal characteristics in respect of health can only be observed in phenomena of disease. It is from observation of these that our knowledge is derived of diatheses or constitutional peculiarities, and of conditions predisposing to overt disease. Of them and their various minglings and alterations by inheritance, and by tendencies to reversion towards health, physiology can give no account; its suggestions cannot be safely used unless

completely subject to the test of pathological inquiry.

It seems certain that many erroneous and too narrow systems of pathology have been dervied from the beliefs of pathologists that they could safely, from the general truths of physiology or even from some section of them, infer what must be true in respect of disease. Hence, by means of inferences from the parts of physiology for the time-being most studied, there have arisen the systems of *vital* and *chemical*, of *humoral* and *neural*, pathology, all containing many truths, but none of them able to stand the test, without which nothing in pathology should be deemed true—the test of a wide and direct study of diseases. It would be well if all systems of pathology which can be thus specially named should be suspected of great error. The science of disease should not be divided or specialised on any other ground than physiology may be, as by the names of *general*, *comparative*, *animal*, *vegetable*, and the like. The study of any one of these divisions, wide as it may be, is not safe unless with frequent reference to the others for their aid ; and every study of diseases of one part or of one kind is very unsafe, unless with a constant consciousness of its narrowness and partiality. Even if it could be made sure that many diseases begin in morbid states of the blood or nervous system, or any other chief constituent of the body, it would be nearly as sure that within a few hours, or even minutes, of their beginning the other chief constituents would be involved. For the relations of the several parts are so intimate and, through the nervous system and the circulating blood, their means of communication are so swift, that if one be diseased none can long remain healthy. There is no truth more necessary to be held in pathology, and in its practical applications, than that the health of each part is a necessary condition of the health of all the rest. JAMES PAGET.

**PAU, in western district of South of France.**—Cool, variable, damp, calm, sedative, winter climate. Mean temperature, winter, 42° Fahr. Much rain and many cloudy days in winter. Soil, gravel. *See* CLIMATE, Treatment of Disease by.

**PECTORILOQUY** (*pectore*, from the chest, and *loquor*, I speak).—A physical sign, connected with vocal resonance, heard on auscultation in some limited parts of the chest. The sounds of the voice in pectoriloquy are directly conducted to the ear, so that the words spoken by the patient may be distinctly recognised by the observer, as if proceeding from within the chest. *See* PHYSICAL EXAMINATION.

**PECTORILOQUY, WHISPERING.** *See* WHISPERING PECTORILOQUY ; and PHYSICAL EXAMINATION.

**PEDICULUS.**—Three species of lice are parasitic on man:—(1) *Pediculus capitis*; (2) *Pediculus vestimenti vel corporis*; and (3) *Pediculus pubis*.

1. *Pediculus capitis.*—This species of pediculus infests the head, especially the occiput, and deposits its eggs on the shaft of the hair, usually not far from the root. The ovum is a small, oval, semi-transparent body, somewhat cupped at its free extremity, and very firmly attached by a short peduncle to the hair. The young are hatched in about five days. The louse when full-grown is about a line in length, the female being larger than the male. The head, thorax, and abdomen, which is oval, are distinct. The head is furnished with two short antennæ, and large, black, prominent eyes. Springing from the thorax are six well-developed legs, armed with strong claws, with which the animal grasps the hair. On the back of the male is seen a conspicuous, elongated, conical organ, the penis. The animal is of a semi-transparent, dirty-white colour, and is covered with short scattered hairs.

2. *Pediculus vestimenti.*—This species closely resembles in shape and general appearance the pediculus capitis, but is of larger size. It infests the under-clothing, with a preference for that of a woolly kind, and it attacks and irritates the parts of the skin that are covered by clothes. The ova are deposited, not on the hair of the skin, but on the wool or fibre of the clothing, and the young are hatched in about five or six days.

3. *Pediculus pubis.*—This is much smaller and relatively shorter than either of the other species, and the line of separation between abdomen and thorax is less marked. The abdomen is short and rounded, which gives the animal a crab-like shape. Like the other species, it has six legs, armed with strong claws for grasping the hair. This louse infests the pubic region, and occasionally the axilla and hairy parts of the face. The ova are found firmly attached to the hairs near the roots.

The different species of pediculi do not bite, as they have no jaws; but they pierce the skin and draw blood by means of a sucking apparatus or *haustellum*, and in this way they derive their sustenance from the human body. Regarded in a pathological aspect, the presence of pediculi is described as a disease under the name of *morbus pedicularis*, or phthiriasis. *See* PHTHIRIASIS.

ROBERT LIVEING.

**PELLAGRA** (*pellis*, the skin, and ἄγρα, a seizure).—SYNON.: Fr. *Pellagre*; Ger. *Pellagra*.

DEFINITION.—An erythema of the skin, *Erythema pellagrosum*, which makes its appearance on the parts of the body most exposed to the light, especially the back of the hands and neck and the breast.

Pellagra has been regarded as a local *coup de soleil*, whence it is likewise called *mal del sole*. The disease being indigenous to hot countries, and common among the peasants in Italy, Spain, and the South of France, it has there received the names of *mal de padrone*, *mal de misere*, *cattivo male*, and *scorbuto Alpino*. It has also been designated by authors *risipola Lombarda*, *rosa Asturiensis*, *lepra Asturiensis*, *elephantiasis Italica*, and *elephantiasis Asturiensis*. These several names point to different features of its history, sometimes alluding to its appearance ; for example, the 'red disease,' *mal de la rosa* ; sometimes to the class of people liable to its attack, namely, agricultural labourers; sometimes to its pre-

sumed cause—the sun, misery, and unwholesome maize (*raphania maistica*); and sometimes to theoretical analogies, as in the instance of scorbutus, lepra, and elephantiasis.

Ætiology.—The local symptoms of pellagra prepare us for the consideration of a neurosis, in which there exists undoubtedly a predisposing cause, as well as an exciting cause and subsequent constitutional disorder. The predisposing causes are heredity, which is unquestionable; poverty; insufficient and improper food and clothing; malaria; and especially unwholesome maize, which constitutes the staple article of diet in some of the countries wherein the disease is endemic. A certain fungus, *sporisorium maydis*, has been accredited with being a special cause of the disease. The sun's rays are regarded as the immediate exciting cause, and its power is more particularly evinced in the spring of the year, and has been expressed by the term 'vernal insolation.'

Symptoms.—The local affection, to the outward eye, is at first an ordinary erythema, with a tendency to centrifugal growth. In the beginning it is of a dark-red colour, without swelling; then it becomes more or less deeply pigmented in the centre; and later on, the area becomes bleached and atrophic, while the margin still remains active. In its early stage the congestion of the skin is attended with tingling and prickling pain; subsequently it loses its sensibility, and is more or less completely benumbed. At a later period of the local disease there occur desquamation, chapping, with exudation and incrustation, and sometimes vesicles and pustules.

The constitutional symptoms of pellagra are such as point to a serious injury of the nervous system. They are:—nausea, vertigo, heat of epigastrium, diarrhœa, lassitude, disturbed vision, cramp and neuralgic pains; the pulse being feeble, the tongue red, and the appetite voracious. These symptoms are attended with prostration of strength and emaciation. They continue for a period of three months, and are liable to be re-excited by every exposure to the sun. The following spring the symptoms return with greater intensity, affecting more and more deeply the nervous system and brain; and finally the patient drifts into dementia, melancholia, or mania. In the later periods of the disease the patient is extremely emaciated; the skin sallow and shrunken; the lips pale; the pulse weak, sixty to seventy in the minute; and the extremities cold and tremulous. Serous effusion occurs in the cavities of the body, cerebro-spinal and visceral; and the sufferers die from exhaustion, sometimes from softening of the brain and spinal cord, sometimes from colliquative diarrhœa, and sometimes from typhoid fever.

Prognosis.—Pellagra is generally fatal after a few years when left to take its course; but it may last for a period ranging between one and sixty years. It is curable, when properly treated, in the proportion of 78 per cent.

Treatment.—The most successful treatment of pellagra is that which may be reasonably deduced from an examination of the causes of the disease, namely, improved hygienic conditions; a sound diet of mixed animal and vegetable food; beer or wine; and tonic medicines, especially quinine, phosphates, and chalybeates. To this general plan may be added, a careful avoidance of exposure to the sun, and the particular treatment needed for complications, for example the nerve-symptoms and diarrhœa. The local treatment should consist in the use of soothing and protective lotions and ointments, such as oxide of zinc and lime-water, or oxide of zinc ointment; and pencilling the margin, when the disease is obstinate, with iodine liniment. In cases of the disease of small extent, such as are occasionally brought to this country from tropical climates, arsenic likewise will be found to be a useful remedy.

Erasmus Wilson.

**PELODERA.**— The name of a genus of 'free nematoids,' one species of which (*P. setigera*, Bast.), according to the determination of the present writer, has been found as a parasite within the human body, under the following circumstances:—In the autumn of 1879 a febrile epidemic prevailed amongst the boys on board the reformatory-school ship 'Cornwall,' which was investigated, and reported upon by Mr. W. H. Power, for the Local Government Board. The symptoms of the disease were in several respects related to those of typhoid fever; in others to those of trichiniasis. Two months after burial, the body of the only boy who had died was examined by Mr. Power and Dr. Cory. From the absence of all characteristic lesions, they decided that this boy had certainly not died from enteric fever. Mr. Power adds:—'This conclusion was more than confirmed by the results of microscopic investigation conducted with reference to trichiniasis. In the very first specimen examined—a few fibres from one of the abdominal muscles—was found a *wandering and living trichina*; and further search revealed the presence of these parasites in most of the muscles examined. Although tolerably abundant, in none of the muscles had the parasite reached the stage of encapsulation.'

Doubts were subsequently expressed in some quarters, as to whether the parasites were trichinæ; and it was suggested that they were free nematoids belonging to the genus *Rhabditis*.

All the existing microscopical specimens were therefore handed over to the present writer. The result went to show that the creatures found were distinctly different from trichinæ. They were in their mature state, of about the same size as embryo or muscle trichinæ, and, as the drawings furnished by the writer show, they exhibited altogether different anatomical characters (see *Ninth Report Local Government Board*, for 1879; *Appendix*). He determined that the organism was a previously unknown species of the genus *Pelodera*, to which he gave the name *P. setigera*.

In relation to the fact that the members of this genus of free nematoids have hitherto been found 'in damp earth and decaying substances,' and especially in fragments of muscle buried in damp earth, it is of importance to bear in mind that these particular nematoids were found alive in a corpse which had been buried for a period of two months. The facts go no further than this, with the addition that the boy died from the effects of an obscure febrile disease. All intermediate links as to source of infection, and as

to the existence of the parasites in the body during life, or even shortly after death, are wanting.

Should subsequent investigation confirm the view that the 'Cornwall' epidemic was occasioned by the presence of the nematoids above referred to, then we should have to admit the existence of two distinct fleshworm diseases in the human subject, the one caused by the trichina fleshworm, and the other by the pelodera flesh-worm. And, just as the one affection is now commonly known as 'trichiniasis,' so might the other be designated 'peloderiasis.'

H. Charlton Bastian.

**PELVIC ABSCESS.**—Definition.—An abscess situated in the pelvis, and generally connected with some uterine affection.

Ætiology.—The causes of pelvic abscess are: 1. Breaking down of tubercles; 2. Suppurative action, the result of broken-down hæmatocele or suppurating ovarian cyst; 3. Inflammation of the pelvic peritoneum; and 4. Inflammation of the cellular tissue in connection with the uterine ovaries, broad ligaments, or the general cellular tissue of the pelvis.

Pelvic peritonitis and cellulitis being often combined, pelvic abscess may arise from the joint action of these causes; and, indeed, after an abscess has arisen, it is very difficult, if not impossible, to differentiate as to its primary origin.

Symptoms.—Pain of a shooting character, with increased local tenderness, accompanied by rigors, sweating, and pyrexia, supervening upon the symptoms of pelvic cellulitis or of pelvic peritonitis, will generally indicate the onset of the affection. *See* Pelvic Cellulitis; and Pelvic Peritonitis.

An abscess having arisen in the pelvis, it conforms to the same general laws as abscesses in other parts, its direction depending upon the tension of the surrounding tissues, an abscess generally burrowing in the direction of least resistance. Thus pelvic abscess may open in the following directions, singly or combined:—1. Through the abdominal walls and saphenous openings. 2. Into the pelvic viscera, as the bladder, rectum, vagina, or urethra. 3. Through the floor of the pelvis, near the anus. 4. Through the pelvic foramina, either obturator or sacro-ischiatic. 5. Through the pelvic roof into the peritoneal cavity. 6. Into the lumbar region, in the position of the kidney.

Such are the many and various courses which an abscess originating in the pelvis may take. Fortunately some of those enumerated are rare, such as opening into the peritoneum. No doubt its starting-point has much to do with its subsequent course, which admits of explanation chiefly on anatomical grounds. Should an abscess open into the peritoneum, then our trouble will no longer be with the abscess, but with the peritonitis that ensues, so that we may lose sight of the primary disease in the gravity of the secondary.

Should the abscess open into the rectum, we shall have a discharge of pus and fæcal matter, of a most fœtid character, by the bowel. On its opening into the bladder long-continued cystitis may supervene. Should a communication become established between these two organs, we shall have the indication of fæcal matter present in the urine.

Treatment.—Pelvic abscess must be treated as deep-seated abscesses in other parts of the body in the early stages, namely, by inducing pointing by hot fomentations or poultices; but when matter has formed the treatment will vary somewhat, according to the position the abscess takes:—1. When the abscess is threatening to point above Poupart's ligament, it is generally wisest not to use the lancet until the skin is seen to be definitely implicated. 2. When the matter is burrowing down the leg, or away from the pelvis, beneath the fasciæ, it must be treated according to the usual rules laid down in surgery for deep-seated abscesses. 3. Should the matter be in the floor of the pelvis, bulging into the vagina and rectum, and highly irritative symptoms exist, then it will be advisable to empty by aspiration, or if pus be clearly observed, to open with full-sized trochar and cannula. When the fluid is evacuated, it is well to pass up a drainage tube, carefully withdrawing the cannula, and leaving the tube in position, through which the cyst should be washed out twice daily with a disinfecting fluid, such as some preparation of iodine; the tube can be removed when the discharge ceases to flow. Should hæmorrhage have occurred in the cyst, the difficulty of evacuation of its contents will be great; in this case it has been recommended to lay open the cyst with a bistoury.

The posture the patient assumes is also of importance, the pus should gravitate to the opening; thus, supposing the opening in the rectum or bladder, then the vertical posture will expedite the cure. In the same way any other position may be assumed which fulfils this end.

The general health must always be kept up by the administration of tonics, good food, and stimulants, so as to counteract the exhaustion due to the prolonged suppuration.

J. Braxton Hicks.

**PELVIC CELLULITIS.**—Synon.: *Parametritis* (Schroeder, Virchow, and Matthews Duncan); *Perimetritis*.

Definition.—An inflammation of the cellular tissue surrounding the pelvic organs, both in the male and female, but much more frequently in the latter, and therefore more especially of the areolar tissue in connection with the uterus and its appendages. Various views have been held with respect to the pathology of pelvic cellulitis, each author giving a name according to his idea of its origin; though, indeed, two distinct affections, pelvic cellulitis and pelvic peritonitis, are described under the general name of pelvic cellulitis.

Ætiology.—The causes of pelvic cellulitis are many and various, but it may be broadly stated that it may arise from any irritation to the mucous membrane, either of the uterus, vagina, or rectum, whether septic or benign. Of these the principal are traumatic, and consequently most cases are seen in connection with the puerperal state, and after operations connected with the female genital organs; but in some persons, due no doubt to some remarkable idiosyncrasy of the patient, the passage even of a sound, or the

retention of a pessary, slight cause as it may seem, is in itself sufficient to excite all the phenomena of pelvic cellulitis. Of the other than traumatic causes may be mentioned dysmenorrhœa, suppression of the menses, and gonorrhœa.

Anatomical Characters.—It was not until Nonat and Bernutz began to study the subject of pelvic cellulitis that any progress can be said to have been made in regard to its pathology. Nonat seems to have considered that the pelvic cellular tissue was chiefly the seat of this affection; whilst Bernutz, writing shortly afterwards, denied that the cellular tissue was in any way affected, and described it as an affection of the pelvic peritoneum; hence we have the term 'peri-uterine phlegmon' of Nonat, and 'pelvi-peritonitis' of Bernutz. Virchow, and Matthews Duncan, following his suggestion, have used the terms 'para-metritis' and 'peri-metritis;' 'para-' signifying an inflammation of the cellular tissue, 'peri-' an inflammation of the serous membrane surrounding the uterus. Schroeder uses the term pelveo-peritonitis in much the same way as Bernutz, and adopts the 'para-metritis' of Virchow. Cruveilhier, Champonièrre, and Tilt have pointed out the share which they believe the lymphatics play in this disease, and to this they give the name of lymphangitis. The terms pelvic cellulitis and pelvic peritonitis appear in the nomenclature of the College of Physicians, and we see no good reason to alter the names. Pathologically, no doubt, the distinction can be made in most cases, but clinically some difficulty arises, and many and various have been the computations as to their relative frequency. Schroeder points out that, even pathologically, the false cyst in pelvic peritonitis may become so thickened as to resemble that of pelvic cellulitis, and as the majority of cases tend towards resolution, and as there is a clinical difficulty as to diagnosis, coupled with their frequent coexistence, there must always be some diversity of opinion as to their relative frequency.

Pelvic cellulitis being caused, as we have said, by some irritation of the genital organs, the question as to the mode of its production, and the part which the different tissues take in its transmutation, has been frequently discussed. Some, after the suggestion of Dance, supposed that the venous system acted the part of the carrier in conveying the *materies morbi*. For a long time the profession were content to receive this as an explanation of the phenomena, until Cruveilhier and Champonièrre showed the part which the lymphatics played in this disease. Besides this, there is reason to believe that, in those cases where the passage of a sound and such-like simple irritants are the cause of pelvic cellulitis, the nerves must play an important part, to account for such a rapid effusion of so much plastic material.

Pelvic cellulitis begins by an exudation of an albuminous nature into the cellular tissue. This, as in other cellular inflammations, may become absorbed, the fluid portion first, and the more solid portion at a later period; or, instead of ending in resolution, it may take on a retrograde metamorphosis, and end in abscess.

The exuded material thrown out in pelvic cellulitis, follows the same steps wherever it may be situated in the pelvis, although its name and clinical symptoms vary according to its topographical distribution. But inasmuch as the effused material is thrown out into the cellular tissue near such a sensitive organ as the peritoneum, the inflammation is liable at any time to spread to and involve this membrane, by reason of its continuity. The peritonitis may either become localised, or may spread and involve the whole membrane, giving rise to general peritonitis; when the latter result occurs it is generally due to a septic cause, frequently spreading with extreme rapidity. It is highly probable that lymphangeitis plays an important part in cases of this kind.

Symptoms.—A small amount of pelvic cellulitis may in itself give rise to very slight symptoms, perhaps merely a sense of uneasiness in the lower portion of the abdomen. This is often the case in slow recovery from the lying-in state, and may be overlooked, a vaginal examination not being deemed necessary, the symptoms varying much according to the rapidity and the quantity of the exudation. Should a large quantity be exuded, the most prominent symptoms will be more severe, namely, more or less tenderness on deep pressure, with dull aching pain in the pelvis, languor, and pyrexia; along with these there may be obstinate constipation and pain in defæcation. Dysuria also may be a prominent symptom. The presence of the last two symptoms will depend upon the situation of the effusion, and its pressure on the rectum and bladder.

*Physical signs per vaginam.*—In the early stage, there being only an effusion of fluid, its detection will be difficult; but as the matter becomes more solid, we shall be aware of a dense mass, usually limited to one or other side of the uterus, but if the amount be large, entirely surrounding the organ. This effusion is generally in the layers of the broad ligaments, either attached to or separate from the uterus, but usually fixed to it; and when the effused matter has had time to consolidate, it is of considerable hardness, similar to that of a uterine fibroid, but generally irregular in outline, often following the form of the roof of the vagina. A uterus fixed by hard, irregular, and immovable swelling is considered by some as pathognomonic of pelvic cellulitis. Pain running down the legs, on flexion and abduction of the thigh, owing to implication of the lumbar nerves, simulating hip-joint disease, is also a valuable diagnostic sign in some cases.

At the onset the temperature generally rises in the evening to 101° or 102°, rarely higher, and is lower in the morning.

The pulse, according to Dr. Galabin, is full in the benign cases; but in the septic form it is dicrotic, and towards the end in fatal cases becomes extremely so. The pulse and temperature form a valuable guide as to the state of the case. Favourable cases may recover in a few days, but generally go on for weeks or months, the absorption gradually taking place, its duration depending much on the general state of the patient and the amount effused. But should the case break down and end in abscess, the presence of this will be shown by increased pyrexia, probably rigors, and localised pain of a shooting

character. For the signs of inflammation extending to the peritoneum, *see* PELVIC PERITONITIS.

DIAGNOSIS.—The diagnosis of pelvic cellulitis from the diseases with which it may be most readily confounded, will be found in the articles on PELVIC HÆMATOCELE, and PELVIC PERITONITIS.

TREATMENT.—When the pathology of pelvic cellulitis is fully considered, it will be seen that the treatment must depend upon the stage to which it has advanced. In the acute stage we should limit ourselves to the administration of salines, and of sedatives for the relief of pain, opium being given internally; and locally, hot fomentations applied to the lower part of the abdomen, and hot injections given *per vaginam*. Leeches are often applied with much benefit to the groin, perineum, or, still better, to the os uteri—three or four at a time, thereby removing any temporary congestion of those parts. The bowels are better moved by an enema, than by purgatives given by the mouth, which if active may cause extension of the inflammation to the peritoneum. When the inflammatory action has subsided, the re-absorption of the plastic material which has been thrown out is assisted by the administration of tonics, as iron and quinine. Iodide of potassium is much relied on by some practitioners, and may be given with advantage combined with tonics; but probably the best means of promoting absorption is by restoring the general health by every method possible. The Americans and Germans recommend the vaginal douche night and morning for about twenty minutes; they believe that it acts as an absorbent as well as a sedative. In the septic variety much success has attended the exhibition of large doses of quinine, five grains every four hours having been given with advantage. In all cases rest is imperatively called for, even after the inflammatory stage is past.

J. BRAXTON HICKS.

**PELVIC HÆMATOCELE.**—SYNON.: Peri-uterine Hæmatocele; Retro-uterine Hæmatocele; Pelvic Thrombus.

NATURE.—Nelaton described this affection as a tense bloody tumour situated in Douglas's *cul-de-sac*, which pushed the uterus forward towards the symphysis pubis. Afterwards every bloody tumour in connection with the pelvic organs came to be so described by some authors. Thus Dr. Barnes classes ruptured uterus with an effusion of blood into the peritoneal cavity as an example of pelvic hæmatocele.

Any effusion of blood which takes place either from ruptured uterus or from other organs is not by most authorities now considered as true pelvic hæmatocele; indeed, blood effused from the liver, kidney, or other organ which has found its way into Douglas's pouch, might thus be included under this name. Pelvic hæmatocele consists of two varieties, to which the names of *retro-uterine hæmatocele*, or better, *intra-peritoneal hæmatocele*; and *pelvic thrombus*, have been given. The first of these affections may be described as an effusion of blood into the retro-uterine sac, subsequently shut off from the rest of the peritoneum by an effusion of plastic material. The second variety, *pelvic thrombus*, is an effusion of blood into the cellular tissue of the pelvic organs, and more especially of that in connection with the uterus. Even with this limitation of applications, the frequency of pelvic hæmatocele has been variously stated by different authors; thus Scanzoni and Schroeder reckon it a rare disease, whilst Zeyfurt reckons it as occurring in 5 per cent. of all uterine cases. Inasmuch as most cases recover, the diagnosis must depend solely on a careful analysis of the clinical history.

It is well, however, that we should distinguish between the two affections, and we shall employ the term *thrombus* as applying to an effusion of blood into the cellular tissue around the uterus, and the term *retro-uterine hæmatocele* to blood which has gravitated into the peritoneal pouch between the uterus and rectum. These distinctions are important, inasmuch as they can in most cases be discovered both clinically and pathologically.

A. **Retro-uterine Hæmatocele.**—ÆTIOLOGY.—The causes of retro-uterine hæmatocele are as follows:—1. rupture of the uterine wall from any cause, including aneurisms and varices; 2. rupture of the Fallopian tubes (hæmatometra) from extra-uterine fœtation; 3. ovulation and ovarian tumour; and 4. rupture of other viscera in the abdominal cavity.

SYMPTOMS.—These will be the same as in the rupture of any viscus, and the escape of blood into the peritoneal cavity. Thus, there will be sudden onset of pain; prostration and collapse, greater than can be accounted for by the anæmia; often vomiting, which is at times excessively severe. Nothing can be felt at first on physical examination, owing to the liquid state of the blood; but as the blood coagulates, hardness will supervene, displacing the uterus—the amount and direction of the displacement depending on the position which the blood assumes. This, as has been pointed out, is generally to be found posteriorly, thus pushing the uterus forward towards the pubes. In a short time inflammatory action may be set up, so as to limit the effusion, and in this case will not be of a severe peritonitic type; but, on the other hand, general peritonitis may be established, which generally ends fatally; or, again, the inflammatory process having become limited by plastic material, it may follow the usual course of pelvic abscess.

B. **Pelvic Thrombus.**—ÆTIOLOGY.—The chief causes of pelvic thrombus are hæmorrhage arising from interruption or suppression of the menses, or from sexual excitement; and hæmorrhage from diminished resisting power of the vessels, in the hæmorrhagic diathesis, scorbutus, or purpura.

Hæmorrhage which has thus arisen may follow the usual course of extravasated blood, namely, coagulation and absorption, or proceed to the formation of an abscess.

SYMPTOMS.—These will depend on the amount of the effusion and its position. In general the quantity will be less than in retro-uterine hæmatocele. It is generally greater when it occurs in the layers of the broad ligament, which it may separate to a very considerable extent, reaching sometimes to the level of the umbilicus. How-

ever, blood effused into the cellular tissue is necessarily under restraint, though the pain would be thereby increased.

In this, as in the affection just described, we have a sudden onset of symptoms, but we do not have such marked anæmia, for the amount of the effusion is hardly so large. And we miss those symptoms of severe collapse which depend upon an effusion of blood into the peritoneal cavity. In fact, here we have more the symptoms of hæmorrhage *per se*, as in any other case of hæmorrhage, the effusion being situated outside the peritoneum. We seldom have symptoms of peritonitis supervening, but rather those due to the displacement which the mass occasions. The effusion may either be absorbed, or it may end in abscess, which pursues the usual course of pelvic abscess. *See* PELVIC ABSCESS.

DIAGNOSIS.—These swellings, produced by blood-effusion, are liable to be confounded with many other troubles about the uterus. The most frequent position is in either broad ligament, where they may simulate fibroma, ovarian tumour, and especially cellulitis of the same part. The next position in frequency is behind, in the cellular tissue between the uterus and rectum, where the hæmatocele may imitate retroflected uterus or tumour in Douglas's pouch. When the hæmorrhage is found at the roof of the vagina, or between the bladder and uterus, it gives the physical characters of a fibroma in the anterior wall, of pregnancy, or of cellulitis. It will thus be seen that the diagnosis depends much on a clear clinical history, either from the patient or her friends, which in some cases is difficult to obtain.

TREATMENT.—This divides itself into two parts, the first of which will be the arrest of the hæmorrhage (should it still be going on); and the second, the application of such means as tend to resolution and absorption of the coagulum. The first indication will be fulfilled by absolute rest, and the administration of hæmostatics, such as gallic acid, lead, turpentine, and other like remedies on which we are wont to place reliance for internal hæmorrhage, combined with opiates. But inasmuch as vomiting is often a severe and prominent symptom, and medicines are with difficulty kept down a sufficient time to be of service, the opiates may have to be given by the rectum or hypodermically. Ice-bags or, if these are not at hand, cold lotions, should also be applied to the lower part of the abdomen, or even introduced *per vaginam*. At the same time a little ice may be given to suck. Small doses of opium, or any of its preparations, repeated at intervals if they can be retained, tend both to quiet the circulation and support the system against loss. Stimulants, however, and hot drinks must be avoided. If rupture of an extra-uterine cyst be supposed the cause, or rupture of an ovarian varix, it may be advisable to perform abdominal section.

The hæmorrhage having ceased, we must still enjoin rest for some time, to prevent its recurrence, and to admit of the blood being absorbed.

In fulfilling the second indication, namely, the resolution of the extravasation, little will be required beyond keeping the system in good general health by the administration of tonics. Iron and quinine are of much service. Some practitioners rely on iodide of potassium as an absorbent; it may be given combined with quinine. Should a recurrence of the hæmorrhage take place at different periods, the bromides and iodides have been considered of some value in quieting the action of the ovaries.

If the case unfortunately end in abscess, the proper treatment will be that of pelvic abscess. *See* PELVIC ABSCESS. J. BRAXTON HICKS.

**PELVIC PERITONITIS.**—SYNON.: Perimetritis (Bernutz, Virchow, and Matthews Duncan).

DEFINITION.—A local inflammation of that portion of the peritoneum surrounding the pelvic organs, and especially the uterus and broad ligaments. *See* PELVIC CELLULITIS.

ÆTIOLOGY.—Pelvic peritonitis is often found as an extension from pelvic cellulitis, both in the puerperal and non-puerperal state. In the non-puerperal state it is associated with uterine flexions and versions; various operations on the genital organs; rupture of ovarian cysts; abscess of the ovary; escape of blood from the Fallopian tube; gonorrhœa; malignant disease; carcinoma; and tubercle.

ANATOMICAL CHARACTERS.—Here, as in cellulitis, the part which the veins, lymphatics, and nerves take is still open to controversy; but the lymphatics, no doubt, take the most important part.

Whatever the origin of the peritonitis we have, in the first place, an effusion varying in character—either serous, plastic, or purulent. The serum may either be absorbed, or become encysted by plastic material, and form a false cyst, which, in an unhealthy condition, may be of a pyoid nature, forming an abscess having the usual characters of pelvic abscess.

But there is this difference from the exudation of pelvic cellulitis and that of pelvic peritonitis, namely, that in cellulitis the exuded material may be absorbed, leaving but few, if any, relics of the bygone inflammation, whilst in peritonitis the fluid portion is chiefly absorbed, leaving very often strings or bands of adhesions matting together the various organs. A not uncommon occurrence is for the uterus, if previously retroflected, to be bound down posteriorly to the sacrum, but it may be equally fixed in any other direction in which effusion has been poured out The effect of these adhesions is curious, for the ovary has been rent from its attachment, and fixed to the pelvic brim posteriorly. These adhesions may stretch and give rise to no permanent displacements, but at other times they are irremediable. Pregnancy seems to have most influence in their removal; and, indeed, this has been suggested as a method of cure. In the same way they may hinder the action of the uterus in labour, and cause pain by their rigidity, though they often hinder conception or give rise to abortion, and sometimes to severe and even fatal obstruction of the bowels. The influence of adhesions should always be borne in mind after any case of pelvic peritonitis.

Should the case end in abscess it may open in any of the ways given under the head of PELVIC ABSCESS.

Symptoms.—In chronic and subacute cases of pelvic peritonitis, the symptoms are usually obscure, the patient (often after childbirth) complaining only of a dragging sensation at the lower portion of the abdomen. These cases frequently pass unnoticed, rest in bed and other remedies sufficing to effect a cure.

In acute cases, the symptoms begin with complaint of a severe pain, increased by pressure, with fixedness of the abdominal muscles in the lower portion of the abdomen, or the coils of the intestine may be seen mapped out. Along with this there is usually a wiry pulse; but if the disease be of septic origin, it may be dicrotic. The temperature is usually above 102°, but varying night and morning. We may also notice a Hippocratic expression of the countenance. Should this become marked we should have reason to fear an extension to the general peritoneum. At the same time we may have constipation, and generally severe vomiting; and by pressure of effused material on the bladder and rectum, there may also arise constipation and dysuria. *Per vaginam*, we may discover a tumour laterally high up in the pelvis, and not easily felt, both on account of the distance from the examining hand, and from the severe pain to which examination gives rise.

But again, it must be pointed out that cases do occur in which nearly all the symptoms are wanting, although the attack may be of a most malignant type, the rapid pulse and pyrexia, coupled with a peculiar expression of the countenance, being almost our only guide. A vaginal examination fails to give us any indication as to its nature, owing to the matter being purulent and fluid. These cases are almost always of septic origin.

Diagnosis.—Pelvic peritonitis may be diagnosed from pelvic cellulitis by the following considerations:—

*Pelvic Cellulitis.*

1. Tumour easily reached; generally easily and early felt in neighbourhood of broad ligament, and above pelvic brim.
2. Abdominal pain, increased by deep pressure.
3. Temperature usually not above 102°; pulse full, soft, dicrotic in septic form.
4. Retraction of thigh with abduction. Pain down leg.
5. Nausea; vomiting, not excessive.
6. Not accompanied by tympanites.
7. Marked tendency to suppuration.

*Pelvic Peritonitis.*

1. Tumour not noticeable for some days.
2. Abdominal tenderness of an acute kind, quickly increased on pressure. Form of coils of intestines mapped out on abdomen. Fixation of abdominal muscles.
3. Temperature above 102° usually; pulse wiry in benign, dicrotic in septic form.
4. Pain down leg and retraction of thigh never present.
5. Nausea; vomiting excessive.
6. Tympanites present in severe cases.
7. Constipation, often marked.
8. Suppuration not often present.

Treatment.—In all cases of pelvic peritonitis, whether acute or chronic, our chief point is rest, and this cannot be too rigidly insisted upon. The stage of the disease, whether chronic or acute, will indicate the amount. Should the case be of a subacute nature, then reclining on a couch will be all that is necessary; but should, on the other hand, the case be acute, however limited in area, then it is essential that we should order absolute rest in bed, as little movement as possible being allowed. In chronic cases this point must be left to the discretion of the physician; it will be for his consideration what part the local condition bears in relation to the general health, and whether continuance of the local trouble will not cease on restoration of the general health.

The next point to be considered—and we know of none in which so much mischief is done by want of appreciation of the true condition—is the administration of purgatives in the acute forms. The same rule holds good here as in the treatment after an operation for hernia, namely, that any increased peristaltic movement of the intestines is liable to cause an extension of the peritoneal complication. We must bear in mind that what the inflamed peritoneum wants is rest, to lessen the friction of the surfaces; and should any unhealthy matter be present, time is urgently required for the effusion of a limiting plastic material, to shut it off from the rest of the abdominal cavity; and after its formation, still further repose is necessary to prevent its being broken down. Thus it is that we find our sheet-anchor lies in the administration of full doses of opium, which not only allays the sensitiveness of the peritoneum, but limits the peristaltic movement of the intestines. If the bowels are unrelieved for fourteen to eighteen days, no harm will accrue. A mild enema of olive-oil and gruel will be the best measure to adopt where necessity requires relief.

In the more chronic cases, for the same reason, we should never purge our patient, for there is always a risk of extending the inflammatory action to the general peritoneum; a mild laxative daily, or, better, an enema, will answer every purpose.

If, from the severity of the constitutional symptoms and the absence of the local, we have reason to believe that we have a case of septic origin to deal with, quinine must be given in large doses, say five grains every four hours, by mouth, by the bowel, or hypodermically. Very marked results have attended the exhibition of this drug in cases otherwise almost hopeless. Sixty grains a day have been given without ill result—indeed with the cure of the patient. Should the peritonitis appear to be of a purely sthenic form, the employment of the old remedy, mercury, will generally be found to be a valuable addition to that of the opiates, at any rate for a short time; but in any case great caution is required lest diarrhœa be induced. In this form the employment of leeches to the abdomen will also assist in the reduction of the inflammation. Care, however, must be observed not to debilitate the patient. Hot opiated fomentations to the lower part of the abdomen in all cases afford great relief. Should the case lapse into a chronic

state, iodide of potassium may be of some service in aiding the absorption of the inflammatory products. The bromide has also been given with the idea of lessening congestion and quieting the action of the ovaries.

At a later date much good will result from the administration of tonics, and from change of air, the local trouble being often kept up by the general condition.

Such are the chief indications of treatment. Vomiting, dysuria, and other complications must be treated on general principles.

J. Braxton Hicks.

**PEMPHIGUS** (πέμφιξ, a bladder).—Synon.: Pompholyx; Fr. *Pemphigus*; Ger. *Blasenkrankheit.*

Definition.—A somewhat rare skin-disease, of indefinite duration; in which blebs or bullæ, containing serous or sero-purulent fluid, form in greater or less numbers on various parts of the body and limbs; burst; dry up, and produce crusts; and finally disappear, leaving temporary stains, but no permanent scars.

Ætiology.—At Vienna Hebra found one case of chronic pemphigus in 10,000 adult persons. In 29,535 patients with skin-diseases of all kinds, excluding the acute exanthemata, there were in thirteen years 66 cases—46 in men, and 20 in women. At Prague, in five years, out of 38,546 sick children, 54 had pemphigus, 24 being boys and 30 girls. Pemphigus is much more frequent in children than in adults, and most frequent in the first eighteen months of life. At Prague 23 of 54 cases were under one month old. In adults all ages are nearly equally disposed to it.

In childhood females seem slightly more disposed than males; in adult life pemphigus vulgaris attacks three times as many men as women. Pemphigus foliaceus is more frequent in women. Neither geographical distribution, season of the year, nor any special diet or habits of life seem to affect the development of the disease. It occurs in persons of all temperaments, and in the healthy as well as in the delicate. No definite relation can be traced between derangements of the kidneys and pemphigus, or between the latter and the gouty or rheumatic diatheses. In a few instances there has been a distinct relation between pregnancy and the outbreak of bullæ. Pemphigus is never endemic. Various epidemics, chiefly among children, have been described by trustworthy writers, of which the latest occurred in 1869 at Halle, and in 1874 in Paris, both in new-born infants, but it seems doubtful whether these were cases of true pemphigus, and not rather allied to varicella. Outbreaks of pemphigus have appeared in more than one case to be determined by a local injury, such as a puncture of the finger. There are one or two instances known in which the disease has been transmitted hereditarily.

A few cases of localised outbreak of bullæ—for example, on one hand and arm—have been reported in connection with injuries of peripheral spinal nerves, and chronic meningitis and myelitis of the spinal cord.

Pemphigus is a non-contagious disease, and all attempts to transfer it from one person to another, by inoculating the contents of the bullæ, have failed.

Anatomical Characters.—In pemphigus the capillaries of a circumscribed portion of skin are dilated with blood, and this hyperæmia is followed by exudation from them of serous fluid, which infiltrates the papillæ and the cells of the rete mucosum, and finally makes its way beneath the epidermis, so as to raise and separate its uppermost layers from the parts below, thus forming a bulla or bleb. The parts of the epidermis which are connected with the hair-follicles resist the pressure longest, but at length give way, and their remains then hang from the under surface of the covering of the bullæ as small threads or processes.

The contents of the bullæ consist at first of nearly pure serum, which gives on heating a flocculent deposit of albumen; later on the fluid contains numerous pus-cells, probably due partly to migration of white blood-corpuscles, and partly to proliferation of the rete cells. Occasionally it contains small quantities of blood exuded from the surface of the cutis. Bacteria were found in one case during life (Sangster). The reaction is at first neutral, but is faintly alkaline in the older bullæ. Soda salts predominate over potash salts. In two cases Jarisch has detected urea. No light has been thrown on the nature of the disease by a chemical examination of the urine, or of the blood, although Bamberger believes that there is an excess of ammonia in the latter.

No *post-mortem* examination has as yet revealed any constant alteration in the organs or tissues which would account for pemphigus. General anæmia, and wasting of the muscles and other parts, have been found in uncomplicated cases, while some patients have died of intercurrent pneumonia and of phthisis. In more than one instance amyloid degeneration of the liver and spleen has been found, just as in other chronic wasting diseases.

Description.—Pemphigus may occur without apparent assignable cause in a previously healthy child or adult. The bullæ may form on a perfectly normal skin, or else a circumscribed portion of skin becomes hyperæmic, and the epidermis over it is raised by a rapid effusion of serum into a bulla, which enlarges quickly, so as to outstrip and cover its base. The bullæ are mostly hemispherical in shape, and may reach the size of an orange, or larger; but, as a rule, they vary from that of a pea to that of a hazel-nut or walnut. Their contents are at first clear and transparent, but in a day or two they become milky and opaque, and finally purulent. The coverings, previously tensely filled, burst; and the discharge dries into flat yellow-brown or blackish crusts. The bullæ tend to a symmetrical distribution on the two sides of the body, and also in some cases to an arrangement in circles or semicircles. They may also spread peripherically, fresh bullæ forming at the edge of the crusts, or stains of old ones. There is no areola or swelling around the bullæ, but red lines are sometimes noticed running outwards from them, probably due to inflamed lymphatic vessels. At the same time as the skin is affected, small bullæ generally form on the

mucous membrane of the mouth, nose, and pharynx; and they have been seen with the laryngoscope on the posterior surface of the epiglottis. They have also been found *post mortem* on the mucous membrane of the bronchi and of the intestines, and are probably the cause of the diarrhœa and bronchitis from which pemphigus patients sometimes suffer. Pemphigus has a marked tendency to recur at longer or shorter intervals, each outbreak being made up of a number of successive crops of bullæ. A few bullæ may in no way affect the general health, but if they are numerous they may be preceded by rigors and fever—102° to 103° Fahr.—and even by delirium and other cerebral symptoms in children. The disease may terminate after one or two attacks, or may recur at intervals and with increasing severity for years, until the patient is reduced in health and strength, and finally dies in a marasmic state, or of some intercurrent disorder.

Classification.—We may divide pemphigus into three main varieties:—1. *P. acutus*; 2. *P. chronicus*; and 3. *P. foliaceus*. Other varieties, such as *P. solitarius*, when only one bulla exists at once; *P. gangrenosus*, where ulcers succeed the bullæ; and *P. pruriginosus*, where itching is a conspicuous symptom, have been described, but they scarcely merit detailed notice.

1. *Pemphigus acutus.*—By this we understand a bullous eruption which occurs only once in the same individual, has a short duration of from three to six weeks, and generally terminates in complete recovery. The existence of such cases, which was at one time doubted, is now certain. In its general symptoms *P. acutus* resembles the acute specific diseases. There is a prodromal stage, a rigor, great prostration, and albumin may appear in the urine (Senftleben). Fatal cases have occurred.

2. *Pemphigus chronicus seu vulgaris.*—This, the *P. diutinus* of Willan, is the most usual form, and the one to which the above description corresponds. This form may assume a malignant character by the number of bullæ present at one time, and by their prolonged duration and rapid recurrence, so that the patient's health is undermined.

3. *P. foliaceus* (Cazenave).—Under this name has been described a form of pemphigus of a peculiarly malignant character. The bullæ are few and small at first, and they are never tensely filled with fluid. Other bullæ form round each central bulla, or else the latter spreads peripherically *per continuum*, until at last nearly the whole surface of the body is involved. At the same time the skin does not heal over the situation of the older bullæ, but remains moist and raw, and covered either with crusts like those of impetigo, or else with the loosened coverings of the bullæ, which form large lamellæ or scales, from which the disease derives its name. The scales have been likened to flaky pastry. This form is happily extremely rare, for it is always fatal.

Complications.—Pemphigus has been seen occurring simultaneously with small-pox, and with purpura. Several cases have been reported in which a form of pemphigus occurred in the early weeks of pregnancy, and continued until delivery. In one case the disease recurred during several successive pregnancies. *Pemphigus pruriginosus* is a name which has been given in cases where the disease has been accompanied by severe pruritus.

Diagnosis.—The fully-developed eruption of pemphigus is too characteristic for it to be mistaken for any other disease. The diagnosis may be difficult at the onset, when only a few bullæ have appeared, or else towards the termination of an attack, when only scabs or stains are left; in the first case the absence of cuniculi will distinguish it from some rare cases of scabies of a purely bullous form. At the outset it may be also necessary to distinguish its bullæ from those occurring in erysipelas; from the use of artificial vesicants; from burns; and from the friction of shoes, clothes, or contiguous portions of skin. The bullæ of herpes iris invariably commence on the backs of the hands and feet; run a rapid course; and assume a concentric circular character. The bullæ which not unfrequently occur in anæsthetic leprosy can scarcely give rise to difficulty, when taken in connection with the maculæ and other phenomena attending it. In long-standing cases of pemphigus, portions of skin which are extensively denuded of their epidermis, may take on a considerable resemblance to eczema rubrum; but the history, the emaciation and weakness of the patient, the dark staining of the skin, with absolute absence of infiltration and only slight irritation, will render it easy to form a decided opinion. Syphilitic pemphigus is distinguished from true pemphigus by occurring only in new-born children; by involving principally, though not exclusively, the palms and soles; by leaving the mucous membranes unaffected; and lastly, by forming thick crusts when the bullæ burst, under which deep ulcers form.

Prognosis.—This is favourable in the early attacks, but doubtful as to the ultimate result, since it is impossible to say whether the disease may end with a single attack, or go on to gradual exhaustion of the patient's strength in the later ones.

Treatment.—No specific remedy for pemphigus has as yet been discovered; the nearest approach to one is arsenic, which in some cases of relapsing pemphigus, especially in early life, exerts a marvellous action on the disease, not only removing all traces of it for the time, but restraining its further invasion during long periods (Hutchinson). In other cases all drugs are equally powerless. The treatment which finds most general approval consists in the administration of tonics, especially quinine or bark and iron, and in supporting the strength of the patient by nourishing food and wine. External treatment consists in puncturing the fully-formed bullæ, and then in coating the parts with zinc, lead, or boracic acid ointment, or else in dusting them with starch or oxide of zinc. In the pruriginous form, preparations of tar and warm baths may be tried. In some cases bran baths, and in others alkaline baths, have been found beneficial, but it is impossible to lay down any line of treatment suitable to all cases.

Edward I. Sparks.[1]

[1] Revised by Dr. Alfred Sangster.

**PENIS, Diseases of.**—Synon.: Fr. *Maladies de la Verge; Krankheiten der Ruthe.*—Taken in their widest sense, the diseases of the penis include a number of conditions which are separately described in this work, such as diseases of the urethra, gonorrhœa, balanitis, gleet, syphilis, and priapism. For a discussion of these subjects the reader is referred to the articles under their several names. In this place there remain for consideration the following morbid states:—1, Congenital abnormalities; 2, Phimosis, acquired; 3, Preputial calculi; 4, Paraphimosis; 5, Inflammation; 6, Gangrene; 7, Herpes preputialis; 8, New growths; 9, Cancer; and, 10, Elephantiasis.

**1. Penis, Congenital Abnormalities of.**—Various abnormalities are from time to time met with in the penis, which are more or less important according to the difficulties in micturition or sexual intercourse to which they may give rise, and the consequent ill effects upon the personal comfort and general health. Among such may be mentioned certain rudimentary conditions of the whole organ, associated or not with defective development of other parts of the genito-urinary apparatus—undue smallness or even deficiency; disproportionate largeness; torsion or lateral deviation; in extremely rare cases, multiplication (double or triple penis); abnormalities in excess or deficiency of particular parts of the organ—epispadias; hypospadias; and phimosis. The three last named require special notice.

(*a*) **Epispadias.**—Definition.—A condition in which, from arrest or defect in development, the upper parts of the urethra and corpus spongiosum are wanting, and the corpora cavernosa are not properly closed together; and in which, consequently, the penis appears more or less completely fissured or opened along its dorsal aspect, and the floor of the urethra is exposed.

Symptoms and Effects.—This condition is most frequently associated with ectopia vesicæ (*see* Bladder, Diseases of); but the defect may be limited to the penis. In most instances the prepuce is long and pendulous below the glans; and this is important, inasmuch as it may often be advantageously used in remedial plastic operations.

The attendant inconveniences and discomforts, such as incontinence of urine and unfitness for sexual congress, though varying somewhat in degree with the extent of the defect, are so great and so constant, that any reasonable attempt at remedy by plastic operation may be considered justifiable. It must be confessed that such attempts have hitherto resulted much more frequently in failure than in success. In some cases, however, much good has been effected; and in others the patients have been enabled to wear apparatus by which their discomfort has been materially diminished. For a description of the various methods adopted, reference must be made to works on operative surgery and special treatises.

(*b*) **Hypospadias.**—Definition.—A condition in which, from defective development of the urethra and of the corpus spongiosum, the urethra opens on the under surface of the penis, at a variable distance behind the glans; and in which, during erection, the penis arches more or less downwards and backwards. The prepuce usually forms a kind of flap, which overhangs, but does not surround the glans.

Symptoms and Effects.—The opening of the urethra, which is often very small and slit-like, may be situated either immediately behind the glans, at any point in the under surface of the body of the penis, or just in front of the scrotum. In the first case—by no means an uncommon condition—no material inconvenience results; micturition and sexual intercourse can, as a rule, be fairly well accomplished; and there is no need for surgical interference beyond the enlargement, if needful, of the urethral orifice. But in cases in which the urethral orifice is far back, the urine passes down the thighs, or backwards; complete sexual intercourse is rendered difficult, painful, or altogether impossible; and the semen cannot be properly intromitted. Such a state of things often occasions great mental distress, and, thereby, impairment of health; and it may become justifiable and desirable to attempt to remedy to some extent the defect by surgical operation. A great variety of methods have been devised and practised, the details of which will be found in surgical treatises. Most of them have resulted in complete failure. But in some few instances very considerable improvement has been effected. As a rule, operative measures should be delayed until adult life is reached.

(*c*) **Phimosis.**—Definition.—A condition, often hereditary, in which the orifice of the prepuce is so small as to render it difficult or impossible to uncover the glans properly and to the full extent. In some cases the orifice is a mere pinhole, or even scarcely discoverable; in others more or less of the glans may be exposed to view. Associated with this condition there is often elongation of the prepuce, usually shortness and tightness of the frænum, and not infrequently undue smallness of the urethral orifice.

It is highly important that the existence of congenital phimosis should not be overlooked or ignored, for at all periods of life more or less serious troubles may arise from it; and accidental circumstances—injury, inflammation, ulceration, &c.—may easily convert a comparatively slight *congenital phimosis* into a severe so-called *acquired phimosis*. At all ages phimosis is liable to interfere with free micturition—in severe cases from mechanical obstruction, in less severe, or even comparatively slight cases, from reflex irritation and spasm. The bladder consequently may not be properly evacuated, and gradually cumulative mischief may result.

Symptoms and Effects.—In infancy and childhood frequent attempts to pass water, accompanied by straining and sometimes screaming, the passage of a small stream, or of a small quantity at a time followed by sudden stoppage; dribbling of the water; irritation and inflammation about the prepuce; and pulling at the penis, are signs and symptoms accompanying, and suggestive of phimosis in the first place, however closely they may simulate the indications of stone in the bladder. General irritability and deterioration of health the production of hernia by frequent straining, balanitis, the acquirement of

the habit of masturbation, and reflex paralyses, are among the evil results that may arise.

In adult life local discomfort, slowness of micturition, imperfect evacuation of the bladder, with all its probable consequences; smallness (from compression) of the glans; difficulty, want of pleasure, or even pain in sexual intercourse; and liability to infection during impure intercourse, are troubles more or less constantly affecting the subject of phimosis; and to these may be added, in more advanced life, increased liability to cancer of the penis.

Treatment.—In comparatively slight cases of phimosis the prepuce may be gradually stretched, and its orifice dilated to the needful extent, by frequently repeated gentle efforts at withdrawing it, and by inserting, between times, strips of dry or oiled lint between it and the glans. In the more severe cases resort to operation is needful. The methods variously adopted are:—(1) Forcible tearing; (2) linear incision to greater or less extent; (3) excision of a portion of the prepuce; and (4) circumcision. The first method is clumsy and altogether to be condemned; the second is easy to perform, but often leaves the part in an awkward condition; the third is incomplete, and rarely satisfactory in effect; the fourth, if carefully and skilfully carried out is uniformly successful, yields excellent results, and, as a rule, is to be recommended.

The best method of performing circumcision consists in first slitting up the prepuce along the median line on the dorsal aspect, by means of a bistoury or scissors, guided by a director, to a point on a level with or rather behind the corona, and in then starting from this point, and with scissors cutting all round, dividing skin and mucous membrane evenly together. As a rule the frænum should be cut; indeed, in most cases it is better to excise a portion. In the infant, sutures are not necessary; but in the adult it is better to stitch the skin and mucous membrane together by very fine sutures inserted as close to the edges as possible. Inrolling is thus prevented, and if the sutures are tied very tightly they will ulcerate out, and the pain and trouble of removing them will be avoided. The simplest dressing only is requisite; but the parts must be kept scrupulously clean, and free from all irritation.

(*d*) **Adherent Prepuce.**—In some cases of phimosis, and occasionally in cases in which the preputial orifice is not unduly small, the mucous membrane of the prepuce adheres, to a greater or less extent, to that of the glans. The smegma and other secretions are thus confined; and considerable local irritation, accompanied by more or less severe symptoms, often closely simulating those of stone in the bladder, may be set up.

Treatment.—The foreskin must be drawn gradually back, the adherent surfaces being separated during the process by the flat end of a probe or other thin blunt instrument; the confined secretions must be removed; the parts washed; the prepuce replaced, unless circumcision has been needful; and strict cleanliness enjoined.

If this condition be overlooked during infancy, the adhesions become firm and dense, and seriously impede the growth of the glans. Their division in the adult may require the use of the knife during circumcision.

2. **Phimosis, Acquired.** — This condition may arise as a result of repeated attacks of inflammation, with or without chancrous ulceration, followed by induration, thickening of the prepuce, and contraction of its orifice. It is most frequent in those who have had slight congenital phimosis. *See* Venereal Sore.

Circumcision is the proper treatment.

3. **Preputial Calculi.** — The subpreputial secretions, if allowed to remain and accumulate, occasionally undergo changes, and become formed into hard concretions, which give rise to more or less serious discomfort and inconvenience. Such concretions are found to consist mainly of phosphate of lime and ammonio-magnesian phosphate, with a variable amount of organic matter.

4. **Paraphimosis.**—Paraphimosis is a condition in which a tight foreskin, having been forced back, during coitus or otherwise, has led to strangulation, œdema, and inflammatory swelling of the glans and a portion of its own mucous membrane. The appearance presented is most characteristic.

Treatment.—Reduction must be effected at the earliest possible moment. If the case be neglected severe inflammation, ulceration, and sloughing to greater or less extent, followed by more or less permanent deformity, are liable to ensue. The method ordinarily adopted consists in grasping the body of the penis between the middle and forefingers of both hands, drawing the foreskin forwards, and at the same time compressing and pushing back the glans by both thumbs. This method is very painful and not always readily successful. A better method, which very rarely fails, consists in slowly bandaging the glans (beginning at the extremity), and all the swollen parts, with a piece of narrow elastic webbing, the effect of which is gradually to empty the engorged vessels and squeeze out the serum from the swollen parts. On the removal of the bandage after a few minutes, reduction is, as a rule, very easily effected. The process may be facilitated by a few needle or lancet-point punctures, made before the application of the bandage.

In some neglected cases it may be needful to divide the constricting band by means of a bistoury. In attempting this it must be borne in mind that the constriction is not immediately behind the glans, but behind the swollen portion of the preputial mucous membrane.

After reduction cooling and soothing applications are useful.

5. **Penis, Inflammation of.**—Synon.: Penitis.—Inflammation of the penis in its totality is very rarely met with except as the result of injury, or in association with severe venereal diseases. In some rare instances it is said to have been induced by excessive sexual intercourse, and in other instances by persistent masturbation. Cases, however, are on record in which it has occurred during, or among the sequelæ of exanthematous fevers.

The treatment must be conducted on general principles, due regard being paid to the cause or

condition in connection with which the inflammation has arisen. If the patient survive, the part may recover.

6. **Penis, Gangrene of.**—Gangrene of the penis, except as the result of injury, or constriction by ligature, rings, &c., in the majority of cases has followed impure sexual congress during a depressed general condition. In some cases it has occurred in association with small-pox, typhus, and typhoid fevers. Death has been the common result. In some few cases life has been preserved, though the part has been lost.

7. **Herpes Preputialis.**—This is a vesicular eruption, occurring on the cutaneous or mucous surface of the prepuce, running its course in about a week, but liable to recur at irregular intervals. A similar eruption sometimes occurs on the glans.

The due recognition of this affection is important, because its appearance after doubtful intercourse often excites alarm, and may lead to mischievous treatment.

Treatment.—The simplest treatment only is requisite. The avoidance or prevention of all irritation by the clothes or otherwise, and sometimes a little sedative lotion, are, as a rule, all that is needful.

8. **Penis, New Growths of.**—*Cystic*, *vascular*, *fibrous*, and other new growths of benign character are occasionally situated on the penis. They may be left uninterfered with, or may be got rid of by operation, according to the inconvenience they cause, and the indications afforded. *Bony formations* or *calcareous deposits* in the fibrous sheaths of the corpora cavernosa are of rare occurrence. The discomfort they have in some instances caused has necessitated their removal by operation, which has been successfully accomplished. *Papillomata*, or warty growths, are not infrequently met with in persons of uncleanly habits. In the majority of cases they are associated with venereal disease; but they may arise independently of such association, especially if the prepuce be long, and due regard be not paid to cleanliness. They may be few and scattered, or many and massed 'cauliflowerlike' together. Sometimes they entirely surround the corona, and sometimes in patches or continuously cover more or less completely the mucous surfaces of the prepuce and glans. In some instances the diagnosis between such growths and papillary epithelioma is not obvious; ulceration of surface indicates the latter.

Treatment.—Removal by curved scissors, or twisting off by forceps, is the most speedily effectual treatment of papillomata of the penis. But if the warts are few and small, they may be made to shrivel and dry up and disappear, by repeated applications of oxide of zinc, calomel, tannic acid, or burnt alum, and the pressure of dry lint between the foreskin and glans. Cleanliness is essential.

9. **Penis, Cancer of.**— Cancer in the male subject in a considerable proportion of cases primarily affects the penis. By far the most common form is *epithelioma*, and the most common seat of first appearance is the glans, or the part of the preputial mucous membrane nearly or immediately adjoining. In comparatively rare cases *scirrhus* is described as having commenced 'lumplike' in some part or other of the body of the organ. In still more rare cases, *soft cancer* has been met with in young subjects after injury, and the diagnosis from suppuration in the corpus cavernosum has at first been doubtful.

Epithelioma seldom appears in the penis before the age of forty, most frequently between the fiftieth and sixtieth years. In 161 cases out of 243 the sufferers had been the subjects of phimosis. In some few instances the origin of the malady has been attributed, rightly or wrongly, to marital connection with wives suffering from cancer of the uterus. Epithelioma is first noticed as a small, warty outgrowth, early ulcerated; or as a flat, excoriated surface, with slightly indurated base, occasionally disposed to bleed, and sometimes painful. Scabs form from time to time, which, when removed, leave exposed a gradually extending ulcerated surface. The malady persists and progresses in spite of treatment, infiltrating and destroying. The discharge is thin and sanious, bloodstained and offensive. The ulcer is irregular in outline, with more or less everted hard edges; and the induration extends into the surrounding parts. Sooner or later the inguinal glands become infected, and the general health seriously deteriorates.

Diagnosis.—The diagnosis of cancer of the penis from any form of venereal ulceration is, as a rule, sufficiently easy. Difficulty can scarcely arise, except in the comparatively rare cases in which there is exuberant warty growth before obvious ulceration.

Treatment.—The only treatment worthy of consideration consists in amputation of the penis, well behind the point to which the disease has extended. If the inguinal glands have become infected, they should be removed at the same time, if practicable. If they are affected to such an extent as to render their removal impracticable, amputation of the penis can do little, if any, lasting good.

10. **Penis, Elephantiasis of.**—Elephantiasis of the penis is almost always associated with elephantiasis of the scrotum, and may demand simultaneous treatment by operation.

Arthur E. Durham.

**PENTASTOMA** (*πέντε*, five, and *στόμα*, a mouth).—A genus of entozoa belonging to the family *Acaridæ*. They are sometimes placed in a separate order termed *Acanthotheca*. The species, two of which are liable to infest man, are characterised by the presence of a ringed or segmented body, the head being armed with four large hooks or claws, arranged in pairs on either side of the mouth. The older writers misunderstood the nature of these cephalothoracic feet; hence the generic misnomer which the term pentastome implies. The so-called *Pentastoma denticulatum* infesting the liver, although tolerably frequent in various parts of Europe, gives rise to no functional disturbance, and is consequently destitute of clinical importance. It is the larval condition of a worm that infests the nasal cavities of the dog, *Pentastoma tænioides*.

The other human pentastome, *Pentastoma constrictum*, infests the liver and lungs, and, on account of its comparatively large size, is capable of giving rise to serious and even fatal symptoms. It measures from half an inch to an inch in length; being also easily recognised by the presence of twenty-three rings. This entozoon not only occurs in Africa, but also in the West Indies, where European residents are liable to be attacked by it. The museum of the Army Medical Department at Netley contains examples of this parasite, from a case in which the entozoon appears to have proved fatal. The history of the case, originally sent by Dr. Kearney, is given by Dr. Aitken in the later editions of his treatise *On the Science and Practice of Medicine*. To this work the reader is referred for other particulars of clinical interest.

T. S. Cobbold.

**PEPTIC GLANDS, Diseases of.** *See* Stomach, Diseases of.

**PEPTONISED FOOD.**—This term may be used as the equivalent of the phrase 'artificially digested food.' In natural digestion albuminoid substances are changed into peptones, and starchy matters are changed into dextrine and sugar. These processes are of a purely chemical nature, and they can be imitated outside the body very closely by means of artificially prepared digestive juices. An extract of the stomach, or of the pancreas, in water, has approximatively the same powers as the natural secretions of those organs. Hence it is possible for us to subject articles of food beforehand to complete or partial digestion; and to administer such artificially digested food to our patients. In cases where the natural digestive powers are more or less in abeyance, it would be an obvious advantage if we had at command a supply of food thus modified, and yet not so changed as to have lost its agreeable appearance and flavour. Nor is there anything repugnant to physiological science or to the custom of mankind in such a proposal. The essential acts of digestion are not vital operations, but chemical transmutations; and the theatre of these operations is on the surface of the gastric and intestinal membrane, and not in the true interior of the body. In the practice of cooking we have, as it were, a foreshadowing of the art of artificial digestion; and although the latter art may never pass beyond the needs of the sick and debilitated—may never serve the healthy and robust—it is not more absolutely alien from the life of animals in a state of nature than is the art of cooking. The practice of cooking is an exclusively human practice, and it is now spread among all the races of mankind, whether civilised or uncivilised; and among the higher races the two most important groups of alimentary substances—albuminoid and starchy matters—are eaten almost exclusively in the cooked condition.

Now the changes impressed on articles of food by cooking are not merely mechanical; nor are they confined to alterations in the appearance and savour of the food. By far the most important changes produced by cooking consist of certain chemical transformations, whereby several of the chief alimentary principles are rendered incomparably more amenable to the action of the digestive juices than in the uncooked state. In a sense we may speak of cooked food as food which has undergone the preliminary stage of digestion. This preliminary stage is accomplished for us of the human race by the artificial aid of heat; but in the case of all the lower animals it has to be accomplished by the labour of their own digestive organs. The affinity of digestion to the process of cooking goes even much beyond this. It has been shown experimentally that albumen, when subjected to the prolonged action of superheated steam, yields a substance resembling peptone, and that starch when similarly treated yields dextrine and sugar. So that it would not be inappropriate to describe digestion as the process of cooking carried a step further.

**Methods of preparation.**—Peptonised or artificially digested food may be prepared, either by following the gastric method with pepsin and hydrochloric acid, or by following the intestinal method, and using extract of pancreas. The latter method yields by far the better results. The pancreas not only acts upon albuminous substances, but also upon starch. Pepsin, on the other hand, is quite inert in regard to starch. Moreover, the products of artificial digestion with pepsin and acid are much less agreeable to the taste and smell than those produced by pancreatic extract. By the latter method articles of food can be profoundly peptonised with little deterioration of that agreeable savour which makes them inviting to the palate. The writer will, therefore, in what follows, confine himself to the pancreatic method, and describe the modes in which food may be partially digested beforehand, and yet constitute an acceptable nourishment for invalids.

The first necessity is to procure an active extract of the pancreas. Water is the proper solvent of the digestive ferments; but, in order to obtain a stable preparation, some preservative agent must be added to prevent decomposition. After a trial of various media the writer has come to the conclusion that, on the whole, the best solvent is dilute spirit. A mixture of one part of rectified spirit with three parts of water answers every purpose. The pancreas of the pig yields the most active preparation; but the pancreas of the ox or the sheep may be employed, if that of the pig is not obtainable. The pancreas of the calf also yields an extract which is active on albuminous substances, but it is not a ctive on starchy materials. In procuring a supply of pancreas from the butcher, it is well to remember that the word 'sweet-bread,' which is the English vernacular for pancreas, is likewise applied to the thymus gland; and that the genuine sweetbread of the kitchen is the thymus of the calf. Butchers distinguish the true pancreas as the 'liver sweetbread,' and it is by this name alone that the pancreas must be asked for in the shambles.

**Mode of preparation of Extract of Pancreas or Liquor Pancreaticus.**—The pancreas is first well freed from fat, and cut up into small pieces with a knife or a pair of scissors. It is then mixed with four times its weight of the dilute spirit, put into a well-corked wide-mouthed bottle, and set aside for a week. The mixture

should be well agitated at least once daily. At the end of a week the mixture is strained through muslin, and then filtered through paper until it is clear.

A very active extract of pancreas is now prepared on the large scale by Mr. Benger, under the name of *Liquor Pancreaticus*, and sent out by Mottershead & Co., chemists, Manchester. As it is a troublesome matter to get a supply of pancreas from the butcher, and as the filtration of the product is a tedious process, it will be found much more convenient to employ Mr. Benger's preparation, if it can be procured, than to rely on home manufacture. In the succeeding instructions for the preparation of peptonised food it will, therefore, be supposed that a supply of Benger's liquor pancreaticus is available.

**Directions for the preparation of various kinds of peptonised food.**—The articles which are most easily prepared, and are most likely to be serviceable to invalids are the following:—

*Peptonised milk.*—A pint of milk is diluted with a quarter of a pint of water, and heated to a temperature of about 140° Fh. Should no thermometer be at hand, the diluted milk may be divided into two equal portions, one of which is heated to the boiling point and added to the cold portion, when the mixture will be of the required temperature. Two teaspoonfuls of the liquor pancreaticus and ten grains of bicarbonate of soda are then added to the warm milk. The mixture is poured into a covered jug, and the jug is placed in a warm situation under a 'cosey,' in order to keep up the heat. At the end of an hour, or an hour and a half, the product is boiled for two or three minutes. It can then be used like ordinary milk.

The object of diluting the milk is to prevent the curdling which would otherwise occur, and greatly delay the peptonising process. The addition of bicarbonate of soda prevents coagulation during the final boiling, and also hastens the process. The purpose of the final boiling is to put a stop to the ferment-action when this has reached the desired degree, and thereby to prevent certain ulterior changes which would render the product less palatable. The degree to which the peptonising change has advanced is best judged of by the development of a peculiar bitter flavour, which is always associated with the artificial digestion of milk. The point aimed at is to carry the change so far that the bitter flavour is just perceived, but is not unpleasantly pronounced. As it is impossible to obtain pancreatic extract of absolutely constant strength, the directions as to the quantity to be added must be understood with a certain latitude. The extent of the peptonising action can be regulated, either by increasing or diminishing the dose of the liquor pancreaticus, or by increasing or diminishing the time during which it is allowed to operate. By skimming the milk beforehand, and restoring the cream after the final boiling, the product is rendered more palatable.

*Peptonised gruel.*—Gruel may be prepared from any of the numerous farinaceous articles in common use—wheaten flour, oatmeal, arrowroot, sago, pearl-barley, pea or lentil flour. The gruel should be well boiled, and made thick and strong. It is then poured into a covered jug, and allowed to cool until it becomes lukewarm. Liquor pancreaticus is then added, in the proportion of a dessert-spoonful to the pint of gruel, and the jug is kept warm under a 'cosey' as before. At the end of a couple of hours the product is boiled, and strained. The action of pancreatic extract on gruel is twofold—the starch of the meal is converted into dextrine and sugar, and the albuminoid matters are peptonised. The conversion of the starch causes the gruel, however thick it may have been at starting, to become quite thin and watery. The bitter flavour does not appear to be developed in the pancreatic digestion of vegetable proteids, and peptonised gruels are quite devoid of any unpleasant taste. It is difficult to say to what extent the proteids of the meal are peptonised in this process. The product gives an abundant reaction of peptone; but there is a considerable residuum of undissolved material. Most of this, no doubt, consists of insoluble ligneous tissue, but it also contains some unliberated starchy and albuminous matter. Peptonised gruel is not generally, by itself, an acceptable food for invalids, but in conjunction with peptonised milk (peptonised milk-gruel) or as a basis for peptonised soups, jellies, and blanc-manges, it is likely to prove valuable.

*Peptonised milk-gruel.*—This is the preparation of which the writer has had the most experience in the treatment of the sick, and with which he has obtained the most satisfactory results. It may be regarded as an artificially digested bread-and-milk, and as forming by itself a complete and highly nutritious food for weak digestions. It is very readily made, and does not require the use of the thermometer. First, a thick gruel is made from any of the farinaceous articles above mentioned. The gruel, while still boiling hot, is added to an equal quantity of cold milk. The mixture will have a temperature of about 125° Fh. To each pint of this mixture two or three teaspoonfuls of liquor pancreaticus, and ten grains of bicarbonate of soda, are added. It is kept warm in a covered jug under a 'cosey' for an hour or hour-and-half, and then boiled for two or three minutes, and strained, If the product has too much bitter flavour, a smaller quantity of the liquor pancreaticus must be used in the next operation. Invalids take this compound, as a rule, if not with relish, at least without any objection.

*Peptonised soups, jellies, and blanc-manges.*—The writer has sought to give variety to peptonised dishes by preparing soups, jellies, and blanc-manges containing peptonised aliment. Soups may be prepared in two ways. The first way is to add what cooks call 'stock' to an equal quantity of peptonised gruel or peptonised milk-gruel. A second and better way is to use peptonised gruel, which is quite thin and watery, instead of simple water, for the purpose of extracting the soluble matters of shins of beef and other materials employed in the preparation of soups. Jellies may be prepared by simply adding the due quantity of gelatine or isinglass to hot peptonised gruel, and flavouring the mixture according to taste. Blanc-manges may be made by treating peptonised milk in a similar way, and then adding cream. In preparing all these dishes it is absolutely necessary to complete the operation of pep-

tonising the gruel or the milk, even to the final boiling, before adding the stiffening ingredient. For if pancreatic extract be allowed to act on the gelatine, the gelatine itself undergoes a process of digestion, and its power of setting on cooling is therefore utterly abolished.

*Peptonised beef-tea.*—A pound of finely minced lean beef is mixed with a pint of water, and ten grains of bicarbonate of soda are added thereto. The mixture is then simmered for an hour and a half in a covered saucepan. The resulting beef-tea is decanted off into a covered jug. The undissolved beef-residue is then beaten up with a spoon into a pulp, and added to the beef-tea in the covered jug. When the mixture has cooled down to about 140° F. (or when it is cool enough to be tolerated in the mouth) a table-spoonful of the liquor pancreaticus is added, and the whole well stirred together. The covered jug is then kept warm under a 'cosey' for two hours, and agitated occasionally. At the end of this time, the contents of the jug are boiled briskly for two or three minutes, and finally strained. The product is then ready for use. Beef-tea prepared in this way is rich in peptone. It contains about 4 per cent. of organic residue, of which more than three-fourths consists of peptone; so that its nutritive value in regard to nitrogenised materials is nearly equivalent to that of milk. When seasoned with salt it is scarcely, if at all, distinguishable in taste from ordinary beef-tea.

*Peptonised enemata.*—Pancreatic extract is peculiarly adapted for administration with nutritive enemata. The enema may be prepared in the usual way with a mixture of milk and gruel, or milk, gruel, and beef-tea. A dessert-spoonful of liquor pancreaticus is added to it just before administration. In the warm temperature of the bowel the pancreatic ferments find a favourable medium for their action on the nutritive ingredients with which they are mixed; and there is no acid secretion (as in the stomach) to interfere with the progress and completion of the digestive transformation. Experience has satisfied the writer that this method of administering nutriment is a valuable resource when the stomach is obstinately intolerant of food, or when there is obstruction in the higher portions of the digestive tract.

**Uses of peptonised food.**—The employment of food which has been wholly or partially peptonised is indicated when the natural digestive powers are from any cause enfeebled or suspended. The most striking benefits have been observed in cases of gastric catarrh with pain and intolerance of food; in gastric ulcer; in the anorexia and dyspepsia associated with valvular heart-disease; and in the various forms of pyloric and intestinal obstruction. Good results have also been obtained in cases of defective nutrition and intestinal irritation in infants. In using peptonised food it is well to remember that it does not keep well, especially in warm weather. Accordingly it should either be prepared twice a day, so that it may be never more than twelve hours old; or, if a quantity sufficient for the twenty-four be prepared at once, the portion which remains over at the end of twelve hours should be reboiled.

WILLIAM ROBERTS.

**PERCUSSION** (*percusso*, I strike).—A method of physical examination, performed by striking gently some part of the body, especially the chest or abdomen, for the purpose of producing certain sounds or tactile sensations. It may be performed either by the finger or fingers of one hand striking the surface directly, or indirectly—the fingers of the other hand being interposed; or by means of a special instrument or instruments. Percussion has been recommended by Dr. Mortimer Granville as an agent in the treatment of certain nervous diseases (*Brit. Med. Jour.* Vol. I. 1882). *See* PHYSICAL EXAMINATION.

**PERFORATIONS AND RUPTURES.** It will be convenient to discuss these lesions together, and from a general point of view only, the more important perforations and ruptures connected with particular organs being treated of in their appropriate articles. The word *rupture* is used here in its true significance, and not in the popular sense as applied to hernia. *See* RUPTURE.

DEFINITION.—Though there is no absolute distinction between *perforations* and *ruptures*, there are certain differences by which they are usually broadly recognised.

The term *perforation* is generally only applied to an artificial opening produced in a hollow organ or tube; seldom, and only under special circumstances, to a lesion affecting a solid tissue. Moreover, it implies that the opening is a small one, or, at any rate, does not reach large dimensions. Again, the mode in which the lesion is produced has, in some instances, to do with the definition of a perforation. Thus, if the opening results from injury by a pointed instrument, or by any other agent which would cause more or less of a puncture, such as a fractured rib penetrating the lung, it would be called a perforation, and in this case the term would apply also to a solid organ or tissue. Finally, the slow destruction of certain structures by aneurisms and other tumours often terminates in an aperture being formed, which is then called a perforation. This is well exemplified by the opening formed in the sternum in some cases of aortic aneurism.

A *rupture* may be associated with any structure, and often involves solid organs and tissues, such as muscles. It implies a lesion of some size, and may reach any dimensions, being more of a tear or rent than a puncture. There is also associated with the term the idea of spontaneous production, or of the lesion originating from within, or from the effects of some compressing or lacerating injury, instead of a penetrating one.

ÆTIOLOGY AND PATHOLOGY.—The causes of perforations and ruptures, and the pathological conditions under which these lesions occur, may be thus summarised:—

1. *Injury.*—This often comes from without, and may be of different kinds. The forms of injury most requisite to notice are perforating wounds; severe compression of the body, as between railway-buffers, which may cause extensive rupture, even of solid organs, without any external mark of violence; violent concussion, as in the case of the brain; and straining, which is especially liable to cause rupture of muscles or arteries. To the category of injuries also belong various causes of perforation or rupture coming

from within, such as corrosives which have been swallowed, bones and other foreign bodies similarly introduced, calculi, hardened fæces in the intestines, and worms. Cases have now and then occurred in which important internal organs have been penetrated in the attempt made by showmen to swallow swords and similar instruments. 2. *Violent actions.*—Voluntary muscles have by their own excessive action led to their rupture, as in cases of tetanus. The uterus has been known to rupture itself. In rare instances the healthy lung has given way from violent cough. 3. *Morbid destructive and degenerative processes.*—These are important causes of perforations and ruptures of various kinds, and they include ulceration or gangrene, as of the stomach or intestine; suppuration, leading to the formation of an abscess, either associated or not with an organ, and which may burst into various internal parts, or externally; cancer; acute fatty degeneration and softening of organs; and chronic fatty, atheromatous, or calcareous degeneration. Some of the conditions mentioned are in themselves essentially destructive; others produce such changes that they render a rupture liable to occur from very little extra force or pressure, such as that which arises from a slight strain, a cough, or the act of vomiting or defæcation, as is well exemplified by the heart and arteries. Even in the case of the destructive processes, some exciting cause may lead to the actual perforation or rupture, such as one of the acts mentioned above, or, in the case of the alimentary canal, the injudicious administration of solid food, or of articles which give rise to flatulent distension. Moreover, after ulceration a cicatrix may be left, which for a time is very liable to give way from slight causes, as sometimes happens in connection with typhoid fever. The perforation of the lung in cases of phthisis is a good illustration of the effects of destructive changes. 4. *Gaseous and liquid accumulations.* These may alone lead to rupture of hollow organs or tubes, of the walls of cavities, or of cysts, by causing extreme distension, as may be exemplified by the occasional rupture of the intestines from over-distension, of an emphysematous lung, of the bladder from an accumulation of urine, of the renal pelvis in cases of hydronephrosis, of a distended gall-bladder, of a pleuritic effusion through the diaphragm, of a hydatid or ovarian cyst, or of an aneurism. Some slight strain or injury may be the immediate cause of the lesion in several of these conditions. 5. *Pressure.*—A tumour of any kind may cause perforation of various structures, as the result of its mechanical pressure. In the case of an aneurism the pulsation assists in producing the lesion. In this way the most resisting tissues may be destroyed, and serious consequences are liable to ensue. 6. *Spontaneous.*—In the case of muscular tissues and arterial structures spontaneous ruptures are supposed to happen occasionally, but probably in all such cases there has been previous degeneration, which has been the real cause of the rupture.

Anatomical Characters.—It must suffice to mention here that the morbid appearances consist of those presented by the perforation or rupture itself; and of the effects resulting therefrom. The former vary much in extent and character in different cases, and no general description can be given of them. As regards the effects produced, there may be none, but very commonly hæmorrhage takes place; or the contents of a hollow viscus, or of a fluid collection, may be found poured out in some abnormal situation, and these usually set up inflammation if the patient live long enough, the results of which will be evident on *post-mortem* examination. In the case of slow perforation of structures by tumours, various effects may be produced, of an irritative or destructive character. Particulars on these points are given in other appropriate articles. In the case of the lung, perforation is likely to lead to the escape of air into the pleura or cellular tissue, thus giving rise to pneumothorax or subcutaneous emphysema. On the other hand, liquid accumulations may open into the lung, and thus be found in the air-passages, or they may produce more or less serious effects upon the pulmonary tissues.

Symptoms.—It is not intended here to describe the symptoms which occur in connection with traumatic injuries, but merely to point out those likely to be noticed in different cases which come under observation in medical practice. Under certain circumstances a perforation or rupture may take place without any obvious symptoms, even when it affects an important structure. This may happen, for instance, even when an opening forms in a hollow viscus, such as the stomach or intestine, provided it has become previously adherent to some solid organ, or to another part of the bowel, with which it then forms a communication. On the other hand, very speedy or even sudden death may ensue, as when a large aneurism or the heart ruptures. The symptoms to be anticipated are those due to the actual lesion itself; and those resulting from the consequences mentioned under the anatomical characters. As regards the lesion itself, if it is suddenly produced, the event is usually attended with immediate marked symptoms. Of these, one of the most common is a sudden pain at the seat of mischief, often very intense, but varying in its characters. When a muscle ruptures, a feeling is frequently experienced as if a severe blow had been struck, and power is lost at once in the affected part. This is well exemplified in cases of rupture of the gastrocnemius, an accident not uncommon at the present day in connection with the game of lawn tennis. When a hollow viscus or any fluid collection bursts, or when gas escapes, a sensation as if something were being poured out is often noticed by the patient. At the same time the general system usually suffers more or less gravely, as evidenced by faintness or actual fainting, or by signs of shock or collapse, from which the patient may never rally, if the structure involved is of great importance in the vital economy, or if continuous hæmorrhage should be going on. The symptoms above indicated may be repeated if the lesion should extend after an interval. It may be mentioned that when rupture of an abdominal organ takes place from severe compression of the body, there may be no symptoms of the event at the outset, and only the development of grave general symptoms indicates what has happened. The occurrence of hæmorrhage into internal parts,

or the escape of the contents of the viscera or of a fluid accumulation, may be obvious on physical examination. Should the patient survive in cases of rupture into internal parts, local and general symptoms pointing to the occurrence of inflammation may be expected to supervene. For instance, in the case of the abdomen there would be signs of peritonitis, or of localised inflammation in some part of the cellular tissue, probably ending in suppuration. In perforation of the lung, symptoms and physical signs of pneumothorax appear, or the presence of air in the subcutaneous cellular tissue may become evident. When an opening is formed between some collection of fluid and any organ or passage which communicates externally, such as the air-tubes or the alimentary canal, such fluid is likely to be discharged in different ways, and this may be a favourable mode of termination, leading to a cure. In the case of slow perforation by a tumour, should it take place in an outward direction, the lesion will probably become evident on clinical examination; if internal structures be affected, the process of destruction may be accompanied with continuous pain, or other symptoms; and subsequently clinical phenomena indicative of implication of various structures arise, either suddenly or gradually. For example, when an aneurism or solid growth destroys any part of the spinal column, this is attended with a continuous aching or grinding pain; and when the canal is perforated, symptoms arise indicating that the spinal cord is involved.

Diagnosis.—It is scarcely practicable to offer any useful general remarks under this heading, and it must suffice to notice the following points. The difficulty of diagnosis varies much in different cases, being sometimes very easy, in other instances more or less obscure or impossible. The practitioner should always be prepared for the possibility of cases of sudden perforation or rupture of internal structures coming under his notice, of which he may have known nothing previously. Under such circumstances a careful inquiry into the previous history may reveal the presence of symptoms of known conditions, which would clear up any obscurity; but, on the other hand, there may be no such history. There ought to be no difficulty, as a rule, if the lesion occurs from some recognised cause, such as certain kinds of injury; or if it supervene in some case under the care of the practitioner for a disease liable to be attended with perforation or rupture of some part, such as typhoid fever, gastric ulcer, an internal abscess, or an aneurism. In the case of slow perforation, it is very important to be able to recognise the meaning of symptoms which may arise from this cause.

Prognosis.—Any rupture or perforation taking place internally must always be regarded as immediately more or less dangerous to life, and not uncommonly the termination is necessarily fatal. Much will depend on the structure involved, the extent of the lesion, and its direct and remote consequences. Caution must be exercised in giving a prognosis in all cases, for some patients recover when such a result might not be anticipated, and especial care must be taken in offering an opinion if the diagnosis should not be quite clear. In the case of ruptures or perforation taking place externally, or affecting structures not essential to life, such as the muscles of a limb, the prognosis of each case must be determined on its own merits.

Treatment.—In the case of sudden internal perforations or ruptures, the first principle in treatment should be to counteract the immediate effects of the lesion, alleviating pain, and rousing and stimulating the patient by appropriate remedies. Opium or morphia and alcoholic stimulants are of great service, and they may often be advantageously introduced into the system by means of enemata, or, in the case of morphia, by subcutaneous injection. Heat to the extremities, sinapisms, and similar applications, are also frequently of much value. The patient should be kept at rest, and it may be of essential importance to endeavour to keep an organ which has been perforated in an absolute state of rest, such as the stomach or intestines, by withdrawing all food, and checking peristaltic movements by opium or other agents. The same applies to some parts of the body, such as a limb, if a muscle or a vessel should be ruptured, and here often the position of the limb is of much consequence. Other appropriate measures will suggest themselves in other instances. Some special interference may be indicated. For instance, it might be clearly allowable to open the abdomen in certain cases; to strap or puncture the chest to relieve pneumothorax; or to cut down and tie a ruptured artery. Hæmorrhage resulting from a lesion of this kind in internal parts, may sometimes be checked by the constant application of ice externally over the corresponding part of the body. The subsequent treatment of cases of rupture or perforation must be determined by the effects which they produce, which must be dealt with according to their nature, each case being considered on its own merits. The same remark applies to cases of gradual perforation by tumours and other morbid conditions.

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**PERICÆCAL ABSCESS.**—An abscess in the cellular tissue around the cæcum. *See* Perityphlitis.

**PERICARDIUM, Diseases of.**—Synon.: Fr. *Maladies du Péricarde*; Ger. *Krankheiten des Herzbeutels.*

The pericardium proper is a membranous bag, one part of which—the visceral layer—closely envelopes the heart and the roots of the great vessels connected with it; while the other—the parietal layer—is loosely reflected round that organ, and has its external surface intimately united with a dense fibrous sheath which passes upwards, and is gradually lost upon the external coats of the vessels, whilst it is continuous below with the central aponeurosis of the diaphragm. A serous fluid bedews the interior of this sac, and facilitates the movements of the heart, so that both in structure and function the pericardium may be regarded as a joint—somewhat modified, no doubt, to suit its internal position, as well as the nature of the parts with which it is connected.

The morbid conditions of the pericardium will be discussed in the following order:—1. Dropsy; 2. Inflammation; 3. Gas in the Pericardium:

4. Malformations; 5. New growths; and 6. Pericardial adhesions.

We may first, however, refer to a condition of the pericardium which can hardly be described as pathological, consisting of slight opacities, which are termed *milk-spots*. These are frequently observed upon the pericardium after death, but they give rise to no clinical symptoms, and are merely to be regarded as callosities due to attrition. The most common situation is at the base of the right ventricle in front, but they are also found on the apex, and are occasionally seen as white stripes upon the auricles, and along the course of the coronary arteries. Such *maculæ albidæ* are most common on large, strong, and hypertrophied hearts, but they are not altogether confined to these. When due solely to attrition, these spots are formed by a mere thickening or condensation of the normal tissue; but now and then they are found to consist of a thin layer of fibrinous matter which may be peeled off, leaving the pericardium beneath opaque, but otherwise natural. In the latter case, of course, these spots cannot be regarded as simple callosities, but as the results of some trifling local pericarditis, running its course without symptoms and of no clinical importance, except as affording a probable explanation of those temporary basic frictions which are occasionally to be heard in those otherwise in apparently good health, as far at least as the heart is concerned.

1. **Pericardium, Dropsy of.**—Synon.: Hydropericardium; Fr. *Hydropéricarde*; Ger. *Herzbeutelwassersucht*.

During life and in health the serosity bedewing the internal surface of the pericardial sac exists in an appreciable quantity, so that an ounce or two of fluid found in it after death is not to be regarded as anything abnormal. When, however, the fluid present amounts to as much as six or seven ounces, or more, the condition is morbid, and is termed *hydropericardium*, or dropsy of the pericardium. The contained fluid is a yellowish, greenish, reddish, or reddish-brown serosity, containing from one to three per cent. of albumen, and occasionally a trifling amount of fibrinous matter, which coagulates on simple exposure to the air—*hydrops lymphaticum* (Virchow, *Gesammelte Abhandlungen*, p. 108). The colour of the fluid is of course due to the amount of blood-colouring matter infused through it; and the reddish, or reddish-brown colouration is specially present when from any cause, such as the co-existence of scurvy, the colouring matter is more readily diffused than usual, or in those exceptional cases where the walls of the capillaries are so altered by nutritive changes as to rupture.

All the phenomena present in dropsy of the pericardium are precisely similar to those associated with a similar amount of inflammatory effusion, and will be referred to under that head. Hydropericardium is a possible occurrence in all diseases, whenever there is, from physical causes, a tendency to transudation of serum into the cavities of the body. According to the nature of that cause it may be either an early or a late phenomenon, and it frequently only attains any considerable proportion during the act of dying. When dropsy occurs from venous congestion due to disease of the heart, or to disease of the lungs, such as emphysema or cirrhosis, some degree of hydropericardium is not uncommon as an early symptom; but when the dropsy results from hydræmia produced by chronic organic diseases of the spleen, liver, or kidneys, or by the exhaustion due to cancerous or tubercular diseases, the pericardial effusion is usually a late symptom.

Treatment.—The treatment of hydropericardium resolves itself into the treatment of the diseases upon which it depends; and it is only when the fluid becomes suddenly effused, in a quantity so large as to threaten death by suppression of the heart's action, that an independent treatment by paracentesis may be found necessary. Such sudden effusion occasionally, but only very rarely, takes place in the course of the acute albuminuria following scarlatina, or even in the more chronic albuminuria, the result of intratubular nephritis.

2. **Pericardium, Inflammation of.**—Synon.: Pericarditis; Fr. *Péricardite*; Ger. *Herzbeutelentzündung*.

Acute inflammation is the most serious, if not the most frequent, affection of the pericardium.

Ætiology.—This disease, though occasionally idiopathic, is much more frequently secondary in its character. So-called idiopathic pericarditis is usually associated with pleurisy, frequently with bilateral pleurisy, and is not uncommonly latent so far as any direct symptoms of pericardial implication are concerned. Secondary pericarditis may be the result of wounds from without or from within—through the œsophagus; of blows and contusions on the præcordial region; of abscesses perforating from the lung, or from the liver—through the diaphragm; of enteric fever, variola, scarlatina, and pyæmia in all its forms; of the spreading by contiguity of the inflammatory process from neighbouring organs, such as the lungs, pleura, or costal periosteum. It may accompany the local development of cancer or tubercle; or may be due to rheumatism, or to one or other of the chronic forms of Bright's disease. By far the larger proportion of cases of pericarditis occur in connection with the two last-named diseases, in about the ratio of two of rheumatic pericarditis to one of renal pericarditis; all other forms lumped together forming an infinitesimal and incalculable fraction. In rheumatism, pericarditis occurs early; occasionally precedes the joint-affection; and though no period of the disease can be regarded as free from the tendency to this so-called complication, just as any joint may be implicated at any period, yet experience teaches us that the heart-joint is most usually affected within the first week of the rheumatic onset. In renal disease, on the other hand, it is most usually a late phenomenon, being only too frequently the immediate precursor of that fatal uræmia which its occurrence serves to precipitate.

The pathology, symptoms, signs, and treatment of pericarditis, however it may arise, are all very much alike, and may be conveniently treated of together.

Anatomical Characters.—The morbid anatomy of pericarditis is simple enough. Very early pericarditis is rarely seen except as associated with Bright's disease, and then at first we have merely vascular injection with a few shreds of lymph visible about the roots of the great vessels. In a few days, in those dry forms of the disease where but little fluid is effused, the whole surface of the heart may be covered with a thin fibrinous layer, which may, even at this early stage, have connected together the visceral and parietal layers of the pericardium somewhat firmly (Wilks). More usually there is some serous exudation mingled with the fibrinous matter, which then is found covering the pericardium in a reticular or honeycomb pattern, which Laennec has likened to the appearance presented on suddenly separating two smooth pieces of wood between which a small pat of butter has been forcibly compressed. The serous effusion not infrequently amounts to several pints; it is always turbid from the molecular fibrin suspended in it; and is of a yellowish, greenish, brownish, or reddish colour. When along with any considerable layer of lymph upon the pericardiac surfaces, there is much fluid effused, the surface of the lymph is covered with shaggy processes floating in the fluid, these processes sometimes presenting a mammillated appearance. In a very short time a fine network of capillaries is developed in the fibrinous exudation; and the rupture of these newly developed capillaries now and then gives rise to what is termed 'hæmorrhagic pericarditis,' in which the fluid, and even the solid lymph, is deeply stained with the blood-colouring matter. This also happens when pericarditis is associated with purpura or scurvy; and now and then, from similar causes, layers of coagulated blood are found alternating with layers of unstained lymph.

When the disease does not prove fatal, the exudation may be entirely re-absorbed, or it may become organised, or other changes may occur. First of all, the excess of fluid and the molecular fibrin become absorbed; then the coagulated fibrin may become worn away by the continual play of the heart, and gradually entirely absorbed; and a complete cure may be thus effected, leaving at the most only a slight thickening or opacity of the pericardium. But such a cure is only possible when the amount of exudation has been inconsiderable. More usually, connective tissue is gradually developed in the fibrinous layers; either locally, giving rise to partial adhesions, which about the base of the heart are more dense, but at the apex are often drawn out to fibrous strings; or the two layers of the pericardium may be so closely united that they can only be separated with considerable force, and now and then, after the lapse of some time, they cannot be separated at all, the cardiac muscle being torn in the endeavour. Occasionally pus, or the cheesy or calcareous remains of such a deposit is found, encysted, as it were, between the adhering layers of the pericardium; and it sometimes happens that this calcareous layer envelops the whole heart, which then seems to be converted into bone. Laennec, Louis, Allan Burns, and others relate cases of this kind, and the heart described by Burns is still preserved in the anatomical museum of the Edinburgh University. In every fibrinous exudation within the pericardium there is at a particular stage a certain amount of all those elements present which may become pus, and these give rise to a milky opacity of the fluid, or if present in sufficient number, may metamorphose the whole exudation into pure pus. This may be only a transition stage; the pus-cells may break down, a pathological cream may be formed, and the whole may be ultimately entirely absorbed. But true purulent pericarditis, though a rare occurrence under any circumstances, is most frequently fatal, and seems to occur chiefly in connection with serious general disease, or to accompany the rupture of local abscesses, pulmonary or hepatic, into the pericardium. What has been termed an 'ichorous exudation' in the pericardium, is simply a putrefaction of that already existing, which becomes brownish in colour and stinking. It may arise from entrance of the air into the pericardium after paracentesis conducted without antiseptic precautions; but it is also believed that such putrefaction may arise in patients greatly enfeebled by exhausting diseases, such as cancer, without any entrance of air into the pericardium. An exudation that has become ichorous may corrode the pericardium; is incapable of further metamorphosis; and is usually speedily fatal by the development of pneumo-pericardium. *See* Pericardium, Gas in.

Symptoms.—The symptoms of pericarditis are of comparatively little importance, because they are frequently entirely absent in those so-called idiopathic forms of the disease which are probably always fatal, as well as in renal pericarditis, which is fatal in the majority of cases; whilst even in rheumatic pericarditis, in which the mortality is at the most only about 16 per cent., and is *nil* according to other authors (Bamberger, &c.), the symptoms, though rarely absent, are generally not very well marked or distinctive. As a rule, if pericarditis be associated with any other serious disease, such as pneumonia, pleurisy, or rheumatism, the symptoms are apt to be swamped by those of the primary disease. In other instances the advent of the pericarditis is indicated by a rigor, a rise of temperature, a feeling of anxiety and oppression at the chest, and the occurrence or increase of dyspnœa. The decubitus is usually dorsal, and syncope is liable to be induced on raising the patient. There is pain in the cardiac region, with palpitation of the heart. The pulse is at first full and frequent, always compressible, frequently irregular, usually dicrotic, and rapidly becomes feeble; and there is a general exacerbation of all the symptoms of the already existing disease. Occasionally the restlessness and anxiety indicative of cardiac implication pass into delirium, which may be low and muttering, wild and maniacal, occasionally accompanied by delusions, and which may be associated with tetanic or clonic spasms, or with convulsions ending in extreme exhaustion, or in death by coma. The occurrence of delirium in the course of rheumatic fever ought at once to direct attention to the heart; and the sudden occurrence of spasms or coma in chronic renal

disease, is only too frequently found to be associated with pericarditis; both of these phenomena being probably caused by the saturation of the blood with the products of retrograde metamorphosis, due to the sudden development of this inflammation. It is only in the very rarest instances that we have that extreme oppression of the chest, violent pain in the cardiac region, hiccough, fainting, and livid countenance, coupled with delirium, and extremely rapid dicrotic pulse, which constitute the classical portrait of pericarditis; and even in those rare cases in which these symptoms are observed, they are rather due to the association of pericarditis with an already existing serious disease, than to the pericarditis itself. In most cases physical examination gives us the first intimation, and in all cases the only reliable information, as to the existence of pericarditis. In all diseases, therefore, in which pericarditis is a possible occurrence, we must carefully examine the cardiac region from day to day, so that we may at once ascertain its occurrence; while at all times, the slightest pain in the chest, or most trifling oppression of breathing, ought to be a sufficient warrant for a most careful physical examination of the chest, because men have been known to go about their ordinary duties—with difficulty, no doubt—even while pericarditis existed.

*Physical signs.*—Whenever on auscultating over the cardiac area we hear a friction-sound, we are justified in assuming the probable existence of pericarditis. And the probability of this surmise is increased just in proportion as we can eliminate all sources of fallacy, and associate it with those symptoms already described as indicative of pericarditis, and with the other signs presently to be described as having the same significance. A friction-sound due to pericardial roughness may be heard over any or every part of the cardiac area, in front or behind. Its most usual position is over the base of the heart in front, and once heard in that position no amount of subsequent effusion suffices to efface it. The sound of such a friction appears superficial, close to the ear; it may resemble only a slight sound of rubbing, the crackling of paper or parchment, or the creaking of new leather; or at times it may simulate so closely the blowing sound of a valvular murmur as to be indistinguishable from such a murmur by the sound alone. Occasionally a friction-sound is persistently absent throughout the whole course of the disease, and that even where there is abundance of fibrin effused. It is difficult to account for this. Some suppose it to be due to mere softness of the fibrin; more probably feebleness of the heart's action has a good deal to do with it, as well as some alteration of the parts — especially the lungs — overlying the heart, which may render them bad conductors of sound.

Friction-fremitus may occasionally be detected by the hand placed over the præcordia, but this is not always to be felt. Apart from fremitus, within the first few days of the onset of the disease, we perceive by palpation an unusually forcible and turbulent action of the heart, which is also occasionally irregular, and is due to inflammatory irritation of the cardiac muscle. By and-by, as the inflammation progresses, cardiac debility sets in, and the pulsation becomes less forcible, while in most cases it is still further obscured by the occurrence of fluid effusion, which separates the apex from the anterior wall, with which the base of the heart always remains in contact. In this way we have produced that phenomenon which is termed 'displacement upwards of the apex-beat,' because the more the true apex is pushed inwards by the effusion, the part of the heart actually in contact with the chest-wall approaches more closely the base of the ventricles. Should the heart be greatly hypertrophied, its impulse may remain distinct throughout the whole course of the disease, the fluid accumulating behind it and not in front.

So long as the serous accumulation is inconsiderable, there is no alteration of the percussion-sound; but whenever this attains an abnormal amount, it is revealed by an increase of the cardiac dulness; and in the ordinary dorsal decubitus of the patient this is first observed at the base, in the line of transverse dulness along the level of the fourth rib. By-and-by, however, the ordinary pyramidal dulness of the heart, base upwards, becomes reversed, and we have a pyramidal dulness with the base below and the apex upwards; and this apex may rise as high as the clavicle, or even above it. The base, on the other hand, may in these cases extend beyond the ordinary position of the apex-beat to the left, especially if the patient be made to lie upon his left side; but it is mobile, and on turning the patient on his right side the dulness leaves the left and passes towards the right. Very great emphysema of the lungs may obscure this dulness, but cannot altogether annihilate it; but of course this method of diagnosing pericardiac effusion can only be put in force when both pleuræ are free from fluid. The fluid effusion, even when confined to the pericardium, may amount to several pints, and its pressure may not only embarrass the heart's action, but may also so compress the lungs, particularly the left one, as to give rise to considerable dyspnœa; and the hindrance thus presented to the free passage of the blood through the lungs may give rise to considerable systemic venous congestion, which is readily observed in the turgid condition of the jugular veins.

As a rule inspection gives us little, if any, information in regard to the existence of pericarditis. Should the quantity of fluid effused be very considerable, and the chest-walls flexible, some vaulting of the pericardial region may be observed, due to the effacement of the intercostal spaces, the ribs being occasionally also more widely separated than usual, at least apparently so; and the whole præcordial space under these circumstances takes a less share than ordinary in the respiratory motions. Undulatory movements due to waves of fluid, as described by some, are never seen; such movements, if visible, depend upon the wobbling of an enlarged and feeble heart, and not on any fluid waves.

Diagnosis.—A friction-sound has been hypothetically supposed to be occasionally due to mere dryness of the pericardiac membrane. Possibly

this may be the case, but it has never been proved. Even if it be the case, then such dryness, associated with the symptoms described, can only be an early stage of inflammation. Apart from these it may or may not be an indication of commencing inflammation, and must be watched and treated accordingly. It has also been alleged that calcareous concretions, and tubercular and carcinomatous roughnesses may give rise to a friction-sound. Associated with the symptoms described, any friction-sound, even presuming such a possible origin, must be regarded as a form of pericarditis, whilst apart from these symptoms it must still be watched with suspicion. The most difficult cases to diagnosticate are those in which the friction-sound is due to pleurisy alone, and is yet audible during cardiac action, when the respiration is temporarily suspended. This is a rare occurrence, but it does happen, and the diagnosis is almost impossible. The subsequent progress of the case may show that the pleura is certainly affected, but that is no proof that the pericardium is not also implicated; or the pericardium may be assuredly diseased, and yet the friction-sound may be solely due to pleurisy. The general symptoms and the condition of the pulse count for something, but the diagnosis between pleurisy and pericarditis is, in such cases, manifestly a difficult one, only to be solved by the further progress of the case. Now and then we have a friction sound audible towards one or other side—usually the left—of the pericardium, during suspension of the respiratory movements; the base of the heart being entirely free from friction, and in these circumstances the probability seems greatly in favour of the strictly pleural nature of the disease. But even in such cases a perfectly accurate diagnosis is impossible. There is never any real difficulty in determining between a valvular murmur and a frictional pseudo-murmur, because in the case of the latter the sound is restricted to the cardiac area, and usually only to a small portion of that, and not being propagated to any extent out of its position of maximum intensity, and then only equally all round, and not in any of the definite lines in which valvular murmurs are propagated. Moreover, the position of maximum intensity of a frictional pseudo-murmur never coincides with that of any valvular murmur, except occasionally with a diastolic aortic one; while, of course, the natural sounds of the heart are never replaced by the pseudo-murmur, though they may be partially obscured by it, and all the secondary results of the valvular lesion simulated are entirely wanting.

Prognosis.—The prognosis in pericarditis is not unfavourable; one in six, or about 16 per cent., is mentioned by some as the ordinary mortality; but according to Bamberger, pericarditis associated with rheumatism or any other curable disease invariably terminates favourably, though the mortality is always large when it is associated with Bright's disease and other incurable affections, the fatal termination of which is hastened by the pericardiac affection. Pericarditis, like any other acute inflammation occurring in an otherwise healthy individual, may be expected to run a favourable course if not unduly treated; and the danger to life is to be calculated by the seriousness of the coexisting complications, and the age and state of the vital powers of the patient. The unfavourable phenomena are, a large quantity of effusion, great dyspnœa, feeble heart's action, small and irregular pulse, lividity, delirium and other nervous symptoms.

Treatment.—The treatment of pericarditis must be regulated to some extent by the nature of the disease with which it is concomitant. If it concur with pneumonia or pleurisy, it may safely enough be entrusted to the remedies employed for these diseases; or should it accompany rheumatism, then we must treat it as part of the rheumatic affection. If we can hopefully employ blood-letting or mercury in the case of rheumatism, then we may employ the same remedies in pericarditis; otherwise there is no reason why we should make use of doubtful and dangerous remedies, simply because the disease has attacked a more dangerous part, but rather the reverse. Those who have shown the smallest percentages of deaths have been the least perturbative in their treatment, as we might reasonably expect. A rheumatic pericarditis ought, therefore, to be treated simply as a rheumatic affection; but inasmuch as pain implicating the heart has a decided tendency to depress its action, it is of the utmost importance to relieve it at once. With this view a large, warm poultice should be applied over the heart; and morphia injected subcutaneously at once, and repeated by the mouth, or subcutaneously, at regular intervals, so as to keep the patient free from pain. Perfect rest must be enjoined. Should there be much dicrotism of the pulse, or any tendency of the heart to fail, then digitalis should be administered at regular intervals, in doses sufficient to keep up the cardiac action, such as ten minims of the tincture every four hours; and with this may be conjoined the use of chloral in five or ten-grain doses, which is not more useful as a sedative than as an antiphlogistic, and which may very well replace the morphia, having the additional recommendation that it does not interfere with the secretions, which demand attention, nor promote the sweating, so troublesome in rheumatism. Where it may be considered advisable to give an alkali, such as potash or ammonia, with the digitalis, it cannot be combined with the chloral, but must be given separately. In recent times, salicin and the salicylates have been employed with success in the treatment of rheumatism. They are not true specifics for this disease, but they tend to keep down the fever, and apparently shorten its course. They do not prevent the occurrence of pericarditis, but their use is not contra-indicated by its presence. Blisters are frequently recommended in pericarditis, but they may tend to irritate the patient and to excite his heart's action. A few leeches often give relief in suitable cases. We must, in fact, treat the pericarditis as part of the general rheumatic attack, only requiring a little more attention than usual in the way of warmth, and relieving pain; and all the past history of this disease proves that we shall in this way be more likely to promote a favourable termination of the disease, than by jeopardising

our patient by dangerous and uncertain medications.

Where the amount of fluid effused is very great, or when the symptoms seem to point to the presence of pus, it may become a question whether paracentesis should be performed or not. The results of this operation hitherto have not been very satisfactory, but that is no reason why it should not be resorted to if it seem necessary, especially as it can now-a-days be so easily done by means of one or other of the aspirateurs. The patient should be placed in the recumbent position, and the needle entered between the fourth and fifth ribs, about half an inch to the left of the sternum, the operation being, of course, performed antiseptically, and the fluid drawn off somewhat slowly. For this reason, therefore, we should be careful in our choice of an aspirateur, as one acting by a powerful vacuum might induce syncope, by withdrawing too rapidly from the heart a pressure to which it has become accustomed. A dilated heart has been said to have been punctured, instead of a distended pericardium, but in the present day such a mistake is scarcely possible, though, of course, it must be carefully guarded against. It now and then happens that after the acute symptoms pass away, the pericardium remains obstinately distended with fluid, and it is, perhaps, chiefly in these cases that *paracentesis pericardii* presents the most hopeful prospects. *See* PARACENTESIS.

**3. Pericardium, Gas in.**—The putrefaction of an exudation causes the development of various gases within the pericardium, and the production of so-called *pneumo-hydro-pericardium.* This condition is readily recognised by the clear tympanitic percussion-note over the usually dull cardiac area, with a metallic gurgling accompanying the cardiac movement. Besides the circumstance already mentioned, pneumo-hydro-pericardium may also be caused by the entrance into the pericardium of gases from the stomach and intestines, or of air from the œsophagus or lung, or *ab externo.*

**4. Pericardium, Malformations of.**—The malformations which may be found in connection with the pericardium are described in the article HEART, Congenital Misplacements of.

**5. Pericardium, New Growths in.**—Both tubercle and cancer may become developed in the fibrinous layers of a pericarditic exudation, usually secondarily to the occurrence of these processes in other organs. This is a very rare circumstance, however, as is also the occurrence of tubercular or cancerous nodules of a secondary character in the substance or on the surface of the pericardium itself, with which a secondary pericarditis speedily becomes associated. In either case, but particularly in the former, the fluid in the pericardium is usually of a hæmorrhagic character when associated with the development of cancer. Now and then tubercular, and still more frequently cancerous, masses are formed in the lungs or mediastinum, and pressing upon the pericardium give rise to pericarditis, which reveals itself mainly by the signs of effusion, and without any direct symptoms of cardiac implication. Such cases are not often recognised during life. The prognosis is always fatal; and the treatment palliative only.

**6. Pericardial Adhesions.**—Pathologically speaking, the most important of all the terminations of pericarditis is adhesion of the two layers, which in its most exquisite form was described by the ancients as congenital absence of the pericardium. This is a state of matters impossible to diagnose, though it may be surmised; and too often it escapes even a surmise, unless the previous history of the case be well known. Very rarely there remains a permanent depression over the cardiac area, the result of pre-existing pericarditis and subsequent adhesion of the visceral and parietal layers, and also of the superjacent pleura. More frequently, but still rarely, this state of matters is revealed by a systolic depression of the parts over the cardiac apex. Even more rarely—because the result of a more extensive inflammation—we have a systolic depression over the scrobiculus cordis, caused by adhesion of the two layers of the pericardium to each other, and to the pleura covering the diaphragm, and concomitant adhesion of the diaphragm to the liver.

It can be only rarely that extensive pericarditis exists without a simultaneous myocarditis, and the results of the latter affection were formerly too frequently referred to the pericarditis itself. An adherent pericardium occurring in early life may hamper the future growth of the heart, and may thus produce one form of so-called atrophy of the heart, with all the consequent results of impaired nutrition. But it is only when the subpericardiac layer of muscular fibres has been involved in the inflammation, that we may have atheromatous or fibrous changes taking place; and, as the result of these, encasement of the heart in a calcareous wall; a local or, more rarely, a general thin and fibrous condition of the cardiac muscles; and either local or general aneurismal dilatation. These results are, however, rare. Hypertrophy is not to be regarded as the result of pericardial adhesion, but of any concomitant lesion which may be present, or of some other cause; for though pericardial adhesion may co-exist with cardiac hypertrophy, it does not give rise to it. In the larger proportion of cases simple pericardial adhesion is to be regarded as not productive of any appreciable untoward results.

G. W. BALFOUR.

**PERIHEPATITIS** (*περί*, around, and *ἧπαρ*, the liver) —Inflammation of the capsule of the liver. *See* LIVER, Inflammation of.

**PERINEPHRITIS** (*περί*, around, and *νεφρός*, the kidney).—SYNON.: Fr. *Périnéphrite*; Ger. *Perinephritis.*

DEFINITION.—An acute or chronic disease of the cellular tissue around the kidney, consisting of inflammatory thickening of, and exudation into, the tissue, frequently followed by suppuration; characterised by fever, local pain, fulness, tenderness on pressure, and in many cases ultimately by fluctuation; and resulting frequently in death, sometimes in spontaneous recovery.

Ætiology.—Perinephritis in most cases originates from pyelitis or suppurative nephritis, by perforation or by extension of the inflammatory process. It is especially related to pyelitis from urinary calculus. It may result from injuries, such as blows, wounds, or severe strains; or from extension of inflammation from neighbouring parts, as from the pelvis, the gall-bladder, or the testicle and spermatic cord. The disease appears in some cases to result from exposure to cold, especially after previous exposure to excessive heat. It arises also in the course of, or as a sequel to fevers, particularly the exanthemata. It is most common in adults, and appears to affect equally the two sexes.

Anatomical Characters.—In the earlier stages the cellular tissue around the kidney is congested; and when exudation has supervened the affected tissue becomes solid and firm. Usually suppuration speedily takes place in the centre of the mass, commencing either at one or at numerous points, and gradually extending. The pus is sometimes odourless, sometimes fœtid. It is important to remember that a fæcal odour may be present without perforation, from the bowel. The perinephritic abscess may become so large as to extend from the level of the liver and spleen to the iliac fossa, and may project so far forward as to protrude the abdominal wall. The pus may burrow and make its way to the surface at the lumbar region, in the lower part of the abdomen, or even in the thigh. More commonly it makes its way into the ureter, or the colon; sometimes into the peritoneum. Occasionally the diaphragm is perforated, and the pus is discharged through the lung. Sometimes rapid gangrene is induced, and sloughy masses are found, mingled with the purulent *débris*. Either without going on to suppuration, or after discharge of the pus, cicatrisation may take place, dense fibrous tissue permanently occupying the place of the structures which had been involved.

Symptoms.—The constitutional symptoms in perinephritis are generally well-marked. The attack may be ushered in by rigors recurring frequently, sometimes periodically. The temperature rises to 100° or even to 105°. The pulse becomes rapid, and either bounding or feeble. The tongue is furred, there is great thirst, the appetite is lost, and there is a tendency to constipation, due in part to the fever, in part to the mechanical pressure upon the bowel. The skin is hot and dry; sometimes there are profuse sweatings, particularly during the later stages of the malady. The local symptoms are pain, usually aggravated by movement, and markedly by pressure; and the presence of a tumour. The tumour rapidly increases, and while it is at first hard throughout, it soon presents deep-seated fluctuation, which becomes gradually more distinct and superficial. The skin in the lumbar region is often œdematous, and is usually pale, excepting when perforation is about to take place. The position of the mass is important. It is situated in the region of the kidney, and is inseparable from it, while as a rule separable from the liver and spleen. The urine may be quite natural, but in many cases it is altered, in consequence of the presence of pre-existing pyelitis or nephritis; but even in cases which do not originate in renal disease, there is a tendency to diminution of the urine at first, and this is apt to continue throughout, accompanied by a dark colour of the secretion.

The onset of perinephritis is generally acute, but it may be very insidious, especially when it follows pregnancy. Probably it sometimes terminates by resolution without going on to suppuration. When suppuration is once fairly established, it extends and makes its way, either to the surface or into some internal cavity. When the pus is making its way outwards, there are the usual features of a burrowing abscess—the skin becomes red and prominent, and at last an opening is formed by ulceration. When the pus makes its way into the colon, a copious discharge of pus by the bowel occurs; and, owing to the nature of the opening, fæcal matter seldom makes its way into the abscess-cavity. If bursting into the ureter occurs, discharge of pus from the bladder takes place. If into the lungs, a sudden discharge may take place with coughing, the layers of the diaphragmatic pleura having been first agglutinated together. With all these modes of termination there is, as a rule, fall of temperature, with relief of the general and local symptoms. When the discharge takes place into the peritoneum, fatal peritonitis is rapidly lighted up. When through the diaphragm, the two layers of the pleura not being adherent, empyema is produced, with sometimes gangrene of the lung. In some instances of perinephritic abscess there is a fatal termination without perforation having occurred, by means of blood-poisoning, either in the form of pyæmia with secondary abscesses, or of septicæmia with affection of the spleen and other blood-glands. In a few cases suppurative pylephlebitis has been met with, accompanied by secondary abscesses in the liver.

Diagnosis.—The concurrence of fever with pain and swelling in the region of the kidney, is distinctive of perinephritis, no other disease presenting this exact combination. The tumour is fluctuating, and is in the immediate neighbourhood of the kidney; it is usually confined to one side; its mass may be tilted forward by pressure on the renal region. It must be distinguished from new formations of the kidney, spleen, liver, or mesenteric glands; from hydronephrosis; and from extravasation of blood into the cellular tissue, due to rupture of an aneurism. From the first group it is distinguished by the fever, and the fluctuation and exact position of the mass; from hydronephrosis by the fever, and the characters of the enlargement; from the aneurismal extravasation by the comparatively slow growth of the tumour, and the absence of the characters of aneurism. In most cases certainty is most readily attained by means of the aspirator.

Prognosis.—The prognosis is always grave, and becomes increasingly so as the disease advances. The duration is commonly short, the case terminating in from a fortnight to a month; sometimes, however, a case lasts several months. A favourable prognosis may be given when perforation outwards has taken place; or when the abscess has burst internally, in such a direction that the pus escapes freely, and there is improvement in the general symptoms.

Treatment.—In the earlier stages counter-

irritation by blistering is useful. The internal use of iodide of potassium, and the external application of iodine, may prevent suppuration. Supporting diet should be given, but not stimulants, unless essentially necessary.

When suppuration has taken place the abscess must be discharged by the aspirator, or by free incision. The latter is preferable, because there are often sloughs or masses of tissue which cannot be got rid of by aspiration. When operation by incision is resolved upon, the incision should be made in the lumbar region through the skin and muscular tissues; and the finger should be introduced into the abscess cavity, to tear down any adhesions which may exist. When the pus has been evacuated, a drainage-tube should be introduced, so as to keep the passage open, and give free egress to the pus. The best results are to be expected when free incision is adopted, and Lister's antiseptic method rigorously employed during the operation and afterwards. The patient's strength must be maintained by nutritious food, tonics, and stimulants when required.

T. Grainger Stewart.

**PERIOD OF INCUBATION.**—The period that elapses between the entrance of an infective substance into the system, and the first appearance of the symptoms of the disease which it produces. *See* Incubation.

**PERIODICITY IN DISEASE.**—In the older physic the periodical phenomena observed in many diseases exercised an important influence upon medical opinion and practice. In the physic of the present day these phenomena, although not disregarded by current pathology, have scarcely a place in therapeutical teachings. An increased precision of medical observation, while leading to the removal of many errors of the older writers on the subject, has begotten a general doubt as to its value in practical medicine, and brought about a, perhaps, too indiscriminate rejection of the earlier views respecting it.

Two English writers, Thomas Laycock, M.D., and Edward Smith, M.D., have in recent years devoted attention to the phenomena of periodicity in disease. Laycock, from a general review of the periodical phenomena observed in menstruation, in utero-gestation of the human and brute female, in the development of the ova of fishes, and in the metamorphoses of insects, came to the conclusion that physiological changes occur in animals every three and a half, seven, fourteen, twenty-one, or twenty-eight days, or at some definite number of weeks. In other words, he came to the conclusion that there are certain 'critical days' in health, days in which there are marked changes in the vital movements, whether that change be for the better or the worse; and that those days may be stated generally as the fourth, seventh, fourteenth, twentieth (or twenty-first), and the twenty-eighth. Further, from a review of the periodical phenomena observed in disease, particularly in the groups of eruptive, intermittent, and continued fevers, and in gout, he endeavoured to show that the changes observed in them followed a similar rule of periodicity to that manifested in health. He saw reason, moreover, having regard to the three-and-a-half-day period noticed, or seven half-days, to revert to the ancient division of the whole day (*νυχθήμερον*) into two parts, here following Graves, who had said: 'We should not count three days and a half, but seven half-days; we should not say seven days, but fourteen half-days. If this method were adopted, many of the apparently critical terminations in continued fevers would, I have no doubt, be found strictly conformable to some regular law of periodicity.' Laycock also saw reason to revert to the ancient doctrine of *critical days in fevers*, and he thus elucidates it: 'In the essay on the judicatory, or critical days, found among the writings of Hippocrates, a critical day is shown to be that day on which certain symptoms will appear, enabling us to ascertain—first, the probable duration or termination of the disease, and, secondly, the symptoms likely to appear on certain future days. The acts of mind which deduced these inferences were termed judications (*judicationes*—*κρίσεις*); and the day on which those acts were to be made was termed judicatory (*κρίσιμος*). So a day might be judicatory—first, of the disease, its course and termination; secondly, of the symptoms to happen on another day. Thus jaundice and hiccup, appearing on the fifth day of fever, indicated a fatal disease; jaundice, on or after the seventh, indicated diaphoresis; on the seventh, ninth, eleventh, and fourteenth (if unaccompanied by hardness in the præcordia), a favourable termination. In pleurisy, if the fever abates on the seventh day, the patient will recover; if it do not, the disease will be prolonged to the fourteenth, on which day it is sometimes fatal. This is the first and plainest exposition of the doctrine of critical days, and, I believe, it is correct.' Laycock then proceeds to make a comparison of the critical days of febrile diseases, and the order of sequence observed by intermittents; and, further, to compare both these forms of fever with the periodicity observed in the exanthemata, and make the facts bearing upon that part of their pathology harmonise with each other. 'The critical days, according to Hippocrates [doubtless here writing, without knowing he did so, of what we now call continued fevers], are:—1, 4, 7, 9, 11, 14, 17, 20, or 21. The paroxysms of a tertian will take place on the $\frac{1}{1}$p. $\frac{3}{2}$p. $\frac{5}{3}$p. $\frac{7}{4}$p. $\frac{9}{5}$p. $\frac{11}{6}$p. $\frac{13}{7}$p. $\frac{15}{8}$p. $\frac{17}{9}$p. $\frac{19}{10}$p. $\frac{21}{11}$p. The paroxysms of a quartan will take place on the $\frac{1}{1}$p. $\frac{4}{2}$p. $\frac{7}{3}$p. $\frac{10}{4}$p. $\frac{13}{5}$p. $\frac{16}{6}$. $\frac{19}{7}$p. And if a continued fever existed with tertian or quartan exacerbations, the more violent symptoms might be expected to appear on the days indicated. On comparing the order of days, discrepancies between the three are sufficiently obvious on a superficial consideration, but many of them disappear on more particular inquiry. . . . With regard to the exanthematous fevers, it will be seen at once that the "critical days" they exhibit occur in quartan order. . . . Exanthematous typhus exhibits the tertian type, and, as might be inferred, the critical days in this fever are the fifth, seventh, ninth, eleventh, and twenty-first. Scarlatina is sometimes tertian, sometimes quartan.'

Since the discrimination of the several varieties of continued fevers, and after the date when Laycock wrote, medical observation has not tended generally to support the doctrine of

critical days, as it relates to this group of febrile disorders, or to confirm the evidence upon which that doctrine appeared to be founded. Murchison's observations (*Treatise on the Continued Fevers of Great Britain*, 2nd edit. p. 187) did not support the applicability to *typhus*; but in this respect, as he notes, they were not in accord with the observations of Gairdner, Russell, and Traube of Berlin. The last-named, indeed, as also Wunderlich, revived the doctrine. *Relapsing fever* may, perhaps, be said to illustrate the doctrine, the paroxysm intermitting on the the third, fifth, or seventh day. According to Murchison (*Treatise*, p. 547) the doctrine fails with respect to *enteric fever*, but he adds that he had 'often noticed' that the disease terminated about the 21st or 28th day. E. Seguin (*Medical Thermometry*, 1876) reproduces the views of Hippocrates on critical days, and Wunderlich's seeming confirmation of them derived from thermometry, himself accepting the 'similitude,' indeed the 'quasi-identity of the results' obtained, in this regard, by the father of Physic and the modern professor. According to Wunderlich's observations the majority of cases of typhoid fever run a regular course, divided into periods corresponding in time with the division into weeks and half-weeks. The ordinary course is about twenty-one days, and Seguin describes an 'effervescence of seven days, a fastigium of seven days, and a defervescence of seven days;' but he adds, with reference to the irregularities which so often mark the disease, 'simple as it looks, how difficult it is to make it out.' In typhus—simple uncomplicated cases—the thermometer marks the fourth day as the height, the sixth to the seventh as the turning point, and a *perturbatio critica* at the end of the second week. 'The doctrine of crises,' says Wunderlich, 'was for the ancients a dogma . . . . for us it must become a law.' Robert Lyons remarks (*Treatise on Fever*, p. 74, 1861): 'We are far from denying that at certain periods febrile disease presents an unmistakable tendency to terminate on critical days; but we think that it is consistent with observation to state that a critical issue of fever . . . . . is far less common in our day than it once was.' And this, indeed, would appear to be a legitimate conclusion from the observations made in this country bearing on the subject. It would almost seem, in fact, on comparing the critical days set forth by the older writers with the order of sequence followed by the paroxysms of intermittent fever, as if the indications of the former, in the progress of the continued fevers of Great Britain at least, had declined with the diminution of sources of paludal malaria.

Laycock, as the general result of his investigation of the *minor* periods—that is, the daily, weekly, monthly, and seasonal recurrences of vital movements—as contra-distinguished from the *major* periods, that is periods measured by a year, or by a series of years, (which he also discussed, but which will be referred to in this article in another connection), laid down the following propositions:—(1) There is a general law of periodicity which regulates *all* the vital movements of *all* animals. (2) The periods within which these movements take place admit of calculations approximatively exact. (3) The fundamental unit,—the unit upon which these calculations should be based,—must for the present be considered as one day of twelve hours. (4) The lesser periods are simple and compound multiples of this unit, in a numerical ratio analogous to that observed in chemical compounds. (5) The fundamental unit of the greater periods is one week of seven days, each day being twelve hours; and simple and compound multiples of this unit determine the length of these periods by the same ratio as multiples of the unit of twelve hours determine the lesser periods.

Inquiring into the causes of the periodical changes in the vital movements of animals, Laycock saw reason to believe that they were in part dependent upon cyclical processes inherent in the system (*esoteric*), partly upon periodic agencies acting from without (*exoteric*), or that they resulted from a combination of the two (*endexoteric*). Prosecuting the inquiry further with special reference to the exoteric agencies, Laycock showed how closely the periodical changes observed in vital movements were linked to the periodical phenomena observed in nature at large, and this not merely with reference to such obvious phenomena as the alternation of sleeping and waking in connection with the diurnal rotation of the earth, and the succession of day and night, but also in respect to the more recondite periodical changes in the vital processes. He set forth data which suggested that those changes, as well as the periodical changes observed in disease, had definite relations to the position of the earth with reference to the sun, and to the position of the sun among the spheres; also to the periodical fluctuations occurring in atmospherical temperature, pressure, and magnetism; and in the magnetism of the earth, whether diurnal, seasonal, or secular. And of the periodicity observed in pathological processes, he endeavoured to show that (whatever the intimate nature of the pathological process might be) neither the beginning, the continuance, the fluctuations, the ending, nor the recurrence could be rightly understood apart from its relations to the phenomena of physiological periodicity on the one hand, and the periodicity of physical phenomena on the other hand. He held that there were not wanting indications in pathological phenomena of a lunar period, and particularly of a lunar cycle (eighteen years, Howard's seasonal cycle); the indications of solar periods were more obvious; and it was to be inferred that in time we should have evidence of greater pathological cycles corresponding with the greater astronomical cycles. Laycock, indeed, saw clearly that so far as exoteric agencies were active in bringing about the periodical phenomena observed, in physiological and pathological processes in man, the changes of least period were linked inextricably to the changes of greatest period, and that the study of the greater periods must be approached, if success were to be hoped for, through the study of the lesser.

Laycock was of opinion that as our knowledge of the periodical phenomena observed in vital changes becomes more exact and extensive, it will be possible to establish a science of *vital proleptics*, having for its object 'to foretell social

and individual suffering'—in other words, a science of *pathological forecasting*.

Edward Smith examined the question of periodical changes in living beings, in health and disease, from a stand-point different from that taken by Laycock. He limited his observations to the human system, and prosecuted a series of researches on the daily, weekly, and seasonal changes it underwent, probably unique in their duration and extent. He adopted as criteria of these changes the rates of pulsation and inspiration, the quantities of carbonic acid expired, of air inspired, and of urea and urinary water evolved. The data as to these several changes were determined by a series of observations made upon himself and others, some phthisical, at hourly intervals, without intermission, throughout the twenty-four hours, during several days in succession, for the daily period, and at daily intervals for the longer periods of time. The fluctuations observed in the different phenomena of health, being taken as indications of changes in the activity of the vital processes, it became possible to determine the progression and retrogression of that activity within the several periods to which the inquiry was directed. These may be briefly stated as follows :—

*Daily period* (*cycle*).—Vital activity is at the lowest between the hours of 1 and 3 o'clock a.m. After 3 o'clock a.m. the activity increases, at first slowly, then more quickly, until a maximum is reached between the hours of noon and 2 p.m. A progressive decline follows, rapid at first, slower as the evening draws on and falls into night, until the minimum is reached between 1 and 3 a.m. The day, in fact, as concerns the changes undergone in the human system may be divided into two periods, one of minimum change (approximatively from 8 p.m. to 8 a.m.); and one of maximum change (approximatively from 8 a.m. to 8 p.m.) Within this daily cycle, smaller cycles are observable, according to the time and quality of the meals.

*Weekly period* (*cycle*).—A weekly period is not shown by a clear line of progression of vital change throughout the week, but by the indications of a higher degree of change which follow upon the first-day rest than are manifested at the close of the sixth day of labour. The evidence of a seven-days' period of change in the healthy system, on the line of investigation pursued by Smith, and apart from the social habit of periodical rest, is obscure; but the social habit is probably the expression of a physiological want of the system.

*Seasonal* (*annual*) *period* (*cycle*).—A seasonal cycle is very definitely marked by the intimate vital changes observed in the human system. Towards the close of summer vital change has reached its lowest point. With the commencement of autumn a progressive increase commences, which continues through the autumn and the winter, and reaches its highest degree in spring. Towards the close of spring vital change begins to decline progressively. This decline proceeds throughout June and July, at an increasing rate in the latter month, and attains its lowest degree early in September. The *summer* changes in the system exhibit the following minimum and maximum conditions: a *minimum* of carbonic acid and vapour exhaled, of air inspired, of the rate and force of inspiration, of alimentation and assimilation, of animal heat generated, of muscular tone and endurance of fatigue, and, in general, of resistance to adverse influence. A *maximum* of the rate of pulsation, of the action of the skin, and the elimination of vapour, of the dispersion of heat, of the supply of heat from without, and of excess of heat, of the elimination of urea and urinary water, of the distribution of blood to the surface, of the imbibition of fluids, of relaxation of the tissues, and of poverty and carbonisation of blood. In the *winter season* the above conditions are, for the most part, reversed. The *autumn season* is marked by the conditions peculiar to the summer or the winter, as the character of the season resembles the one or the other; it is essentially a period of change from the minimum to the maximum. The *spring season* is characterised in its early and middle parts by the highest degree of efficiency of every function of the human system, but as the season advances to the close, these conditions merge into those peculiar to summer.

The effect of season, Ed. Smith observes, is more than the physical phenomena of temperature and atmospheric pressure explain, and is so universal that even the same amount of exertion, made at two different seasons, produced different degrees of effect upon the vital changes—less carbonic acid being evolved from it in summer than in winter, in proportion to the relative amounts when at rest at these two periods.

The periodical changes here set forth have important bearings both upon the liability to and the treatment of disease. Smith endeavoured to formulate these bearings and thus to furnish a rational statement of many facts which the experienced practitioner learns at the bedside, and which he applies empirically.

But the interest of the seasonal period is more conspicuously marked as it influences the liability to and recurrence of disease and particular kinds of disease. And here it should be noted that Ed. Smith discusses a question which, perhaps, has been too little considered, namely, the viability of children born in the different seasons of the year. This question he believed to have an important bearing upon the great loss of infant life which occurs in the summer season. Smith concludes that the viability of those children is greatest who are born in the winter and spring months.

The periodical fluctuations observed in the progress of current diseases in the course of the year appear to be mainly determined by the influence of seasonal changes on the individual. This subject has recently been examined by Alexander Buchan and Arthur Mitchell, M.D. (*Journal of the Scottish Meteorological Society*, Nos. xliii.–xlvi.), with reference to the variations of mortality in relation to the weather for different diseases, at different ages, in London, for a period of thirty years. The results obtained by these gentlemen are of exceptional value for the length of period over which it has been practicable to extend their examination—a period unattainable, for a like number of diseases and approximate correctness of data, in other ætio-

logical records. A series of researches made by Edward Ballard, M.D., on the prevalence of certain sorts of sickness, in a particular district of London, with reference to meteorological conditions, corresponds closely with the results shown for the mortality in similar kinds of sickness by Buchan and Mitchell, the minima and maxima of the sicknesses necessarily preceding by a longer or shorter period the minima and maxima of the mortality arising from them. The general results obtained from the London mortality may be taken as representing the influence of seasonal changes on disease; but the progress of the diseases will be found to follow the progress of the seasonal changes, as these may be found to differ in, and may be modified by, different localities. The following is a brief tabular statement of the seasonal mortality of the more important diseases current, or occasionally present, in London:—

| | Winter. | | | Spring. | | | Summer. | | | Autumn. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | March | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
| Small-pox | + | + | + | + | ‡ | + | − | − | = | − | − | − |
| Measles | + | − | − | − | + | ‡ | + | − | − | − | + | ‡ |
| Scarlatina | − | − | − | − | − | − | − | + | + | ‡ | + | + |
| Diphtheria | + | + | − | − | − | − | − | − | + | + | ‡ | ‡ |
| Quinsy (16 years) | + | + | + | − | − | − | − | = | − | + | + | ‡ |
| Croup | + | + | + | + | − | − | − | − | − | − | + | + |
| Whooping Cough | + | + | + | + | + | − | − | = | = | = | − | + |
| Fevers | + | − | − | − | − | − | − | − | + | + | + | − |
| Typhus (6 years) | + | + | + | + | − | − | + | − | − | + | − | + |
| Typhoid (6 years) | + | + | − | − | − | = | − | + | + | + | ‡ | + |
| Simple contind. fever | + | + | ‡ | − | − | + | − | − | + | − | − | + |
| Erysipelas | + | + | − | − | − | − | − | − | − | + | ‡ | ‡ |
| Puerperal fever | + | + | + | − | − | − | − | − | − | + | ‡ | + |
| Dysentery | − | − | − | − | − | − | + | + | ‡ | + | − | − |
| Diarrhœa | − | − | − | − | − | − | ‡ | ‡ | + | − | − | − |
| Cholera | − | − | − | − | − | − | ‡ | ‡ | + | − | − | − |
| Rheumatism | + | + | + | + | + | − | − | − | − | − | + | + |
| Privation | − | − | − | − | − | − | + | + | + | − | − | − |
| Purpura and Scurvy | − | − | + | + | + | + | − | − | − | − | − | − |
| Alcoholism | − | − | − | − | + | + | + | + | + | − | − | − |
| Thrush | − | − | − | − | − | − | + | + | + | + | − | − |
| Gout | + | + | + | + | + | − | − | − | − | − | − | − |
| Phthisis | + | + | + | + | + | − | − | − | − | − | − | + |
| Tabes Mesenterica | − | − | − | − | − | − | + | + | + | − | − | − |
| Hydrocephalus | − | + | + | + | + | + | + | − | − | − | − | − |
| Heart-disease | + | + | + | + | − | − | − | − | − | − | + | + |
| Laryngitis | + | + | ‡ | + | + | − | − | − | = | − | − | + |
| Bronchitis | ‡ | + | + | + | − | − | − | = | − | − | + | + |
| Pneumonia | + | + | + | + | − | − | − | = | − | − | + | + |
| Asthma | ‡ | + | + | + | − | − | − | = | − | − | + | ‡ |
| Pleurisy | + | + | + | + | − | − | − | = | − | − | + | + |
| Lung-disease | + | + | + | + | − | − | − | = | − | − | + | ‡ |
| Enteritis | − | − | − | − | − | − | + | + | + | + | − | − |
| Teething | + | + | + | + | + | − | − | − | − | − | − | − |
| Old age | ‡ | + | + | + | − | − | = | − | − | − | − | + |

\+ Above the average. ‡ Maxima.
− Below the average. = Minima.

This table indicates the seasons of prevalence of the several maladies above and below the average, as shown by their mortality, also the seasons of maximum and minimum prevalence, but it does not exhibit the order of progression and magnitude of movement of the diseases in the different seasons. In this place, however, we are concerned solely with the fact of periodical changes in the prevalence of disease corresponding with and, it is inferred, depending upon the seasonal changes. These changes, while occurring more or less in each of the particular affections, and notably in certain groups of affections, such as the diarrhœal and pulmonary, manifest widely varying relations between the several kinds of maladies, except in the groups referred to and the different seasons.

*Periods of Seasons or of Years.—Epidemics.*—A series of periodical phenomena have now to be considered which have been a source of the most eager speculation from the earliest times of medicine to the present day. So far as medicine is concerned these periods have been marked by epidemic morbid phenomena—epidemics in man, epizootics in animals, epiphytics in plants. The recurrence of these phenomena at intervals shows that over and above the periodical morbid changes which have hitherto been noted, and which are completed within the day, the week, or a series of weeks, and the seasons within a year, there are periods of change which require for their completion a series of years of longer or shorter duration, and which for their elucidation (as Laycock showed) require to be considered in connection with the previously-mentioned periods. These periodical morbid phenomena are of two sorts, the one relating to particular localities, districts, or countries (*epidemics*); the other to groups of several countries or to the world generally (*pandemics*). There are, in fact, circumscribed (local) and general epidemics, the small and the great epidemics of some writers; the former, local evolutions of disease having relation chiefly to the physical and moral states of communities, the latter, secular evolutions (to use Charles Anglada's phrase: *Maladies Éteintes et les Maladies Nouvelles*, 1869), which appear to have relation to, as yet, undetermined cosmical phenomena. To these secular evolutions of disease ('facts of cosmo-chemical disturbance'—John Simon) some epidemiologists would restrict the term epidemic.

The law of periodicity of the several diseases current in a country, and which are apt to become epidemic, has not been determined. Each disease will need to be considered apart; and in those which are communicable from the sick to the healthy, the influence of an accumulation of susceptible persons in the intervals between epidemic prevalence[1] will have to be distin-

[1] The writer has the following from a mathematical friend:—As a first case, let all epidemics be of equal intensity; and let there be no condition operative in determining an epidemic beyond the accumulation of susceptible people.

Let $p$ be the number of susceptible people remaining in a population after an epidemic.

Let $r$ be the annual excess of births over deaths (all causes), with other increments of susceptible population.

Let $x$ be the number of people attacked, or otherwise rendered insusceptible during an epidemic.

And let $n$ be the cycle of an epidemic.

To find $n$.

After an epidemic, the susceptible $= p$.
Next year " " $= p+r$.
" " $= p+2r$.
When epidemic comes " $= p+nr$.
After epidemic gone " $= p+nr-x$.
But this $= p$.

$\therefore nr = x$; and $n = \frac{x}{r}$.

On this rule, take the case of scarlatina (always present and waiting to be epidemic until accumulation of $nr$ over and above $p$ has taken place, and let us suppose ourselves concerned with a community of 1,000, of whom a

guished from extraneous conditions presumably operative in determining the periodicity. Thus, after the year 1840, the fluctuations of small-pox in the metropolis were observed to have a close relationship with the fluctuations in quantity of unvaccinated children—so close, indeed, that the periods of recurrence of epidemic small-pox could be pretty certainly forecasted; but in 1871, when one of the periods of epidemic increase arising from an accumulation of unprotected individuals was due, some other undetermined condition concurred and gave to the epidemic of that and the following year a character which had not been observed in small-pox since the general introduction of vaccination. The usual histories of epidemics are almost valueless for scientific purposes: they do not discriminate those outbreaks which are essentially of a local nature, and dependent chiefly upon the state of a particular place and population, from those which are governed by more widely operative influences. In England the data available for such determination do not exist for more than forty years. Previous to the compulsory registration of deaths, and for a short time afterwards, the records of the causes of death (which can alone at present be applied to the purpose) were too imperfect to be made use of, and the popular accounts of the recurrence of maladies were untrustworthy. From the Registrar-General's Reports, for the 28 years 1850–77, it may be inferred that *small-pox* was epidemic in 1850–52; 1858; 1863–65; and in 1871–72. *Measles* in 1851; 1854; from 1858 to 1863; in 1866; 1868; and 1874. *Scarlet Fever* in 1857–58; 1863–64; 1868–70; and in 1874. *Diphtheria* from 1859 to 1866. *Whooping Cough* in 1850; 1854–55; 1857–58; 1861–63; 1866–67; and 1872. '*Fever*,' from 1851 to 1855; in 1857–58; from 1862 to 1866; and in 1868. *Erysipelas* from 1850 to 1856; 1858–59; 1864; and 1874–75. *Puerperal Fever* in 1864–65; and from 1870 to 1876. *Dysentery* from 1850 to 1859. *Diarrhœa* in 1852; 1854; 1857; 1859; 1865; 1868; and 1870–71; the mortality from this cause being moreover in excess throughout the whole period 1867–74.

certain number are insusceptible, and another number ($p$, it does not at present matter what number) are susceptible:—then

let $r=2$ (births – deaths yearly, &c.);

and let $x=10$ (attacks in an epidemic, probably about one death);

then $n=\frac{x}{r}=5$ years as the cycle of epidemic recurrence.

Now, in the same community, with the same $r$, let $x$ be greater than in another otherwise similar community (*i.e.*, when the epidemic comes it attacks more people, making them insusceptible); the interval between successive epidemics will also be greater; thus if $x=20$, $n=10$ years, and so on. On the other hand, if $r$ be larger (either through large birth-rate or other immigration of susceptible persons) while $x$ is constant: the interval between successive epidemics will be less; thus, if $x=10$ and $r=3$, $n=3\frac{1}{3}$ years, and so on.

So, again, fluctuations in the amount of $p$ (from whatever cause arising) will make a difference in the quantity $p+nr$, the number requisite for the appearance of an epidemic; and the interval between successive epidemics can be altered in this way as well as by change in $n$ or $r$.

Take now the case of an epidemic influence needing to be introduced from without, and supposing the degree of its intensity not to vary; with this alteration of hypothesis the cycle of an epidemic will not be less than the time $n$, but may be indefinitely greater, owing to the requisite introduction not taking place.

It is easy, in these considerations, to find reasons for differences in epidemic cycles among different communities, for differences in the intensity of successive epidemics, and for apparent alterations of susceptibility among communities. And these reasons will deserve to be considered before going in search of other reasons.

With regard to cholera and 'fevers' it must here be noted that Robert Lawson holds, from a widely-extended range of observation, that a series of fluctuations may be distinguished in the prevalence of cholera and 'fevers' following in regular sequence at intervals of two years. These fluctuations are common to both hemispheres, and as they appear to move from east to west, he has designated them '*pandemic waves*.' These waves have a definite relation, he believes, to the magnetic isoclinal lines, and he has laid down rules for determining their position at any time. (*Trans. Epidemiological Society of London*, vol. iii. p. 216.)

The facts relating to the secular evolutions of diseases are amongst the most interesting, if the most lugubrious, in the history of the human race. Although their too-frequent obscurity and their extreme complexity have hitherto interposed an insuperable barrier to the construction of a general doctrine regarding their occurrence, it is not the less necessary that they should receive attention. Here it is possible only to note some of the more salient indications of secular periods of morbid evolution. The following illustrations (chiefly according to Anglada) may be mentioned:—

(*a*) The great pestilence of the 5th century before Christ, of which the so-called 'plague of Athens,' as described by Thucydides, was an incident.

(*b*) The pestilences of the 2nd and 3rd centuries of the Christian era, which are believed to have been of the same nature as the pestilence of the 5th century B.C. After the 3rd century this form of pestilence disappeared from history.

(*c*) The explosion of bubonic (inguinal) plague in the 6th century after Christ, when, for the first time in history, this formidable disease assumed the epidemic character which it maintained to the early part of the present century. Breaking out in the reign of Justinian (A.D. 542), the disease quickly occupied the whole of the then known earth, and began a tragic course which has continued even to our own time. For twelve hundred years it had held a pre-eminence among pestilential maladies, sometimes more, sometimes less prevalent, but at all times deadly. In the 16th century, when quarantine was established (*see* QUARANTINE), 69 outbreaks of the disease were recorded in Europe, of which five happened in England; in the 17th century, 56, six in England; in the 18th century, 28, none in England; and in the first half of the 19th century, 15. In the 17th century, the area of prevalence of the disease began to decrease. This decrease went on progressively throughout the 18th and the commencement of the 19th centuries, the latest outbreaks of the malady, however, being not less fatal than the earliest; and in 1844 it apparently became extinct. But about ten years afterwards the disease again showed itself in the Levant, and from that time to the present scattered circumscribed outbreaks have occurred in Western Arabia, (1853, 1874, and 1879), North

Africa (1855–59 and 1874), Mesopotamia (1867 and 1873–77), Persia (1863, 1870–71, and 1876–77), and after an absence of thirty-six years from Europe in the province of Astrakhan, Russia (1878–79). Here, then, we appear to have records of one complete secular evolution of plague, and to be witnessing the beginning of another.

The 6th century most probably also gave birth to or determined a new phase of activity in small-pox, measles, and even scarlatina, as great epidemics.

(*d*) The gangrenous pestilence of the middle-age (10th, 11th and 12th centuries), a disease long extinct.

(*e*) The *black-death* of the 14th century, a disease held by the most competent writers to differ essentially in nature from bubonic plague, and long extinct—unless, indeed, according to some writers, the Pali plague of India is to be regarded as the dregs of the *black-death* of the 14th century. *See* PLAGUE.

(*f*) The *sweating sickness* of the 15th and 16th centuries, which, born towards the close of the former century, after five visitations (1485–86, 1507, 1518, 1529, and 1551) disappeared, about the middle of the latter century.

Also, the great epidemic of *syphilis* of the 15th century.

(*g*) The *choleraic pestilence* of the present (19th) century.

(*h*) The exceptional development of fatal *diarrhœa*, especially of *infantile diarrhœa*, in this century.

(*i*) The occasional extension of the *yellow fever* of the tropics into Europe, notably at the beginning of the present century.

(*j*) The great development of *diphtheria*, a disease that had been well-nigh forgotten, within the past thirty years.

(*k*) The appearance within recent years of *cerebro-spinal fever*.

In these phenomena we have evidence of secular pathological changes, to which a clue is sought in studying their relation with secular meteorological and telluric changes. In the epidemics of short recurring periods—the lesser epidemics, so to speak—it is becoming possible to construct a theory of recurrence, founded on the relationship of man to his physical and social surroundings, and the periodical changes which he and they undergo in common and in subordination to the periodical changes observed in Nature at large, and when the disease is communicable in relation to the number of susceptible people among a community. In the epidemics of long-recurring periods—the greater epidemics—the same conditions obtain; but it would appear as if there were in addition some slowly-developed cumulative influences at work, which manifest themselves only after long intervals of time. So far as these influences may consist in meteorological changes we look principally to India, where these changes are more uniform in their occurrence, for the earliest clear light on the subject. There, for example, cholera is constantly present—now as a disease endemic to a particular region, now as a wide-spread epidemic within the limits of the peninsula, but ever and anon breaking its bounds and spreading pandemically throughout the world. James L. Bryden, M.D., has shown that the different developments of cholera within the boundaries of India have very definite relations to particular meteorological phenomena; and it seems not unreasonable to suppose that, following the line of research inaugurated by him, in progress of time it will become possible to discriminate between the meteorological changes which determine or concur with epidemic prevalence of the disease within India, and those which determine or concur with wider extensions of the malady—such as affected Europe in 1829–37, 1847–50, 1852–56, 1865–67, and 1869–73. Blandford's meteorological researches promise much help in this direction, inasmuch as they are tending to show a close relation between the greater cycles of meteorological change in India and cycles of meteorological change in the sun's atmosphere, particularly as observed in the sun-spot period.

It might here be added that the late researches of Crudeli and Klebs on the development of the *bacillus malariæ* in the blood in intermittent fever, and the well-known observations on the appearance and disappearance of the spirillum in relapsing fever, seem to suggest a connection between the periodical character of these diseases and the life-cycle of these organisms.

J. NETTEN RADCLIFFE.

**PERIOSTEUM, Diseases of.** *See* BONE, Diseases of.

**PERIPHERAL** (περί, around, and φέρω, I carry).—Of or belonging to the periphery or circumference, as opposed to the centre. The term is now applied chiefly to morbid conditions connected with nerves or their terminations, as distinguished from those situated in the nerve-centres, for example, *peripheral paralysis*, *peripheral pains*. Peripheral may also be associated with the vessels, as distinguished from the heart, for example, *peripheral resistance*; and with the outer zone of the lobules of glandular organs, as, for instance, of the liver.

**PERIPNEUMONIA NOTHA** (περί, around, πνεύμων, the lungs, and νόθος, false).—An obsolete term, which was formerly vaguely applied to a variety of forms of acute inflammation of the bronchi and lungs.

**PERIPROCTITIS** (περί, around, and πρωκτός, the anus).—DEFINITION.—Inflammation of the tissues surrounding the rectum.

The lumen of the rectum is normally, except in the act of defæcation, obliterated by the mucous membrane being thrown into folds from contraction of the muscular coats of the bowel; so that a transverse section of it in this state would present the appearance of a solid oval, with the long diameter transverse. During defæcation the bowel is distended by the passage of fæces, and in persons subject to constipation or flatulence this distension is often found considerably increased by accumulations of fæces or of flatus. The rectum is, in order to admit of this mobility, surrounded by a considerable quantity of loose cellular tissue, which below passes by direct continuity into the masses of adipose tissue which fill the ischio-rectal spaces.

In consequence of the dependent position, the comparatively great exposure to injury, the vas-

cularity and the liability to congestion from the junction of the portal and systemic venous systems, this cellular tissue is very liable to inflammation, which usually goes on to suppuration.

Periproctitis may be either *acute* or *chronic*.

Ætiology.—*Acute* inflammation around the rectum may be of traumatic origin. Unskilful catheterisation in the male subject, by which the point of the catheter is forced through the urethra into the space between the bladder and rectum; penetrating wounds of the bowel, caused by instruments, such as injection-tubes, stricture-dilators, &c., or by foreign bodies introduced by patients themselves, or by sharp substances, such as fish-bones, which have been accidentally swallowed; gunshot wounds of the part; penetrating wounds, caused by falls on sharp substances; or even contusions, the result of falls or kicks, may set up such inflammation. Or it may be the result of extension of inflammation from surrounding parts. Thus prostatitis, cystitis, pericystitis, ulceration in the membranous portion of the urethra, sloughing ulceration of the vagina, and the various kinds of ulcers in the rectum, may be the exciting cause. If perforating ulcers be the cause, so as to lead to extravasation of urine or fæces, the inflammatory process is very severe. In some rare cases no exciting cause can be traced, and such cases are known by the misleading name of 'spontaneous periproctitis.'

*Chronic* periproctitis always results from the extension of inflammatory processes from neighbouring parts. Disease of the sacrum, coccyx, or lower lumbar vertebræ, or chronic disease of the pelvic viscera, often leads to it. It is characterised by considerable infiltration and thickening of the cellular tissue, as well as by suppuration. Pyæmia resulting from ligature of hæmorrhoids may be attended by abscesses in this tissue; which also, though very rarely, have been found in pyæmia from other causes.

Symptoms.—In acute cases the patient complains of a feeling of weight in the part, and of pain, which is much greater during defæcation. As the thickness of the integument in this region, and the fasciæ of the part retard the pointing towards the surface, extensive mischief may exist with little external sign. Hence the importance in all suspected cases of careful digital exploration of the rectum, by which local tenderness, increased temperature, and either hardness or fluctuation, according to the stage of inflammation, may be detected. In chronic cases the symptoms are usually masked by those of the exciting cause.

Treatment.—In all cases accumulation of fæces in the rectum must be prevented by the use of simple enemata; whilst in acute cases early surgical interference is imperatively required. In other cases, the exciting cause must be discovered and treated according to circumstances.

Jeremiah McCarthy.

**PERITONEUM, Diseases of.**—The peritoneum is by far the most extensive serous membrane in the body, while it has numerous folds and attachments, and is in relation with several organs and structures, so that the consideration of its diseases, though similar in their nature, is a much less simple matter than in the case of the other membranes of this class. It must also be remembered that in the female the peritoneal cavity is in direct communication with the uterus, through the Fallopian tubes. The morbid conditions of the peritoneum may be discussed according to the following arrangement:—



1. **Peritoneum, Acute Inflammation of.**—Synon.: Acute Peritonitis; Fr. *Péritonite aiguë*; Ger. *Acute Bauchfellentzündung*.

Ætiology and Pathology.—Acute peritonitis may arise under several conditions, which can be conveniently included under certain heads.

*a. Traumatic.*—It was formerly believed that any kind of injury to the peritoneum was highly dangerous, and would lead almost inevitably to inflammation. Not only, however, may it be punctured with an aspirator or trochar without any harm resulting, but it may even be freely opened and manipulated, under proper conditions, without any injurious effects, as is constantly exemplified in the operation of ovariotomy, and in performing abdominal section for various other purposes. At the same time a very slight operation affecting the peritoneum may lead to serious or even fatal peritonitis, especially in certain states of the system, or if septic matters are introduced into its cavity. Penetrating wounds of the abdomen are very likely to be followed by peritonitis, but not necessarily. The rupture by violence of an abdominal organ will also lead to this result, should the patient survive long enough, from the escape either of blood, or of the contents of a hollow viscus. Peritonitis has been attributed to a mere contusion over the abdomen. When it arises from a wound, it is probably not the simple injury to the peritoneum that causes the lesion, but its exposure to the air, the introduction of septic matters, or hæmorrhage into the peritoneal sac.

*b. Perforations and Ruptures.*—In addition to lesions due to injury, there are several other kinds of perforation and rupture which are liable to give rise to peritonitis. These have been discussed at length in a special article (*see* Perforations and Ruptures), and it will suffice to mention here, that acute peritonitis may follow either of the following forms of perforation or rupture, if they do not prove fatal too speedily:—(i.) of hollow viscera, with escape of their contents; (ii.) of solid organs which have become so softened as to give way; (iii.) of cystic or other localised accumulations of fluid; (iv.) of collections of pus in connection with any structure within the abdomen, even the peritoneum itself, or in the abdominal wall; (v.) of an aneurism; (vi.) of a dilated receptaculum chyli; (vii.) of fluid accumulations within the chest, which have burst through the diaphragm into the abdomen, such as empyema, pulmonary abscess, or a hydatid cyst. The peritonitis depends mainly on the materials which thus gain access into the peritoneal sac, whether gaseous, liquid, or solid, and which irritate it more or less according to their nature. Urine is one of the most virulent of such materials; and unhealthy pus or gangrenous particles are also highly injurious. The nature of the irritant will also materially influence the kind of peritonitis which is set up.

*c. Direct irritation of the peritoneum.*—This is a common source of peritonitis, and the irritation may be *general*, affecting more or less the whole peritoneum; or *local*. Thus it is supposed that *general* irritation may result from distension of the peritoneal sac in cases of ascites; and certainly from extensive morbid deposits, such as cancer or tubercle. *Local* irritation may be excited by many different conditions, including mere mechanical pressure or friction, as from a tumour, an enlarged cancerous organ, or an accumulation in the bowels; as well as localised inflammation, suppuration, ulceration, or gangrene. A very severe form of peritonitis is liable to be set up by a strangulated hernia or certain forms of acute intestinal obstruction; and this complication has also to be borne in mind as a result of mere local irritation in typhoid fever, and in dysentery. In some instances a minute and careful search has to be made for the source of irritation before it can be discovered; for instance, it may be merely a suppurating absorbent gland, deeply situated. Peritonitis thus originating may be limited, or may spread universally, this depending very much on the nature of the irritant. Extension is due either to the products of inflammation passing along the sub-serous cellular tissue, or being conveyed by the absorbent vessels.

*d. Extension.*—Besides the extension of peritoneal inflammation from a local irritation, it now and then happens that pleurisy or pericarditis, especially if of a septic nature, spreads through the diaphragm to the peritoneum, probably by means of the system of lymph-canals existing between the serous membranes and the diaphragm. Inflammation may also pass along the Fallopian tubes directly from the uterus to the peritoneum. In this connection it may further be mentioned that infectious emboli in branches of the abdominal aorta have given rise to peritonitis; which has also been attributed to phlebitis and peri-phlebitis, extending from the umbilical and spermatic veins.

*e. Secondary.*—This term refers to cases of peritonitis originating as a complication or local manifestation of some general condition. Under such circumstances the disease usually results from a morbid or poisoned state of the blood—especially when it contains products of excessive tissue-change as in low fevers, abnormal materials, or infective agents. Other causes may, however, assist in its development. The most important diseases in which secondary peritonitis occurs are Bright's disease; septicæmia and pyæmia, to which puerperal peritonitis probably belongs; erysipelas, small-pox, glanders, and other diseases of this class; and perhaps acute rheumatism and gout. It has also been said to follow scurvy; but in a large number of cases of scurvy, which have come under the observation of the writer, peritonitis never occurred.

*f. Idiopathic.*—Occasionally cases of peritonitis occur, which cannot be referred to any of the recognised causes. These have been called *idiopathic*, and have been attributed to exposure to cold, excessive eating or drinking, and various other causes in individual instances. Many authorities, however, doubt their reality.

*g. Contagion.*—Peritonitis may be originated by contagion, when of the puerperal variety, and may thus become epidemic.

**Peritonitis in Females.**—A few special remarks are called for on this point. Peritonitis is much more common in females than males, on account of the relation of the peritoneum to the uterus, and the various conditions connected with the genital organs and functions which are liable to affect it. The following are the principal of these conditions to which peritonitis has been referred:—(1) the uterine congestion attending menstruation, aided by the effects of cold, especially if this should give rise to inflammation of the womb; (2) the puerperal state and its accidents, puerperal peritonitis being a most important form of the disease, which is discussed separately; (3) premature delivery, and especially the use of instruments in procuring abortion; (4) extra-uterine pregnancy; (5) local diseases, such as inflammation of the substance of the womb or its lining membrane, or in the vicinity of the organ; ovaritis; uterine or ovarian tumours; peri-uterine hæmatocele; and inflammation or ulceration of the Fallopian tubes; (6) gonorrhœal inflammation spreading upwards; and (7) injections into the cavity of the uterus.

Predisposing Causes.—In addition to sex, age has to be regarded as a predisposing cause of peritonitis. It is very rare in children, except in new-born infants, in whom it occurs comparatively frequently, either from inflammation or mortification of the umbilicus, or umbilical hernia; or as the result of infection from the mother. The affection is said to be not uncommon in the fœtus, causing its death. In children peritonitis is usually associated with the acute exanthemata or pyæmia, even sometimes following vaccination; but it may also be due to tubercular disease or intus-susception, and in very rare instances has been traced to an undescended testis, or to injury in administering an enema. Peritonitis is predisposed to by previous attacks; and, it is said, by accumulation of fæces, and excessive use of strong purgatives habitually. Chronic renal disease may be regarded as a powerful predisposing, as well as an exciting cause of the complaint, a very slight irritation readily setting it up when this affection is present.

Anatomical Characters.—The pathological changes in peritonitis present much variety under different circumstances, as regards their nature, progress, and extent; and although they resemble in a general way those observed in other serous inflammations, they exhibit in most cases distinguishing peculiarities of a striking kind.

In the early stage increased vascularisation is always noticed, but it may subside at a later period, or be obscured by the inflammatory products. There is capillary injection more or less diffused, the vessels being enlarged and elongated. This is often very marked, giving rise to intense redness, frequently not uniformly distributed, but being especially observed where coils of intestine touch each other, and at the starting-point of the inflammation in certain cases. Small extravasations of blood are not uncommon, and may be numerous.

The products of the inflammatory process are very variable, as regards both their nature and

amount. In certain cases they consist almost entirely of a fibrinous exudation or organisable lymph, with a very little serum, often more or less tinged with the colouring matter of the blood, and containing flakes of lymph—*adhesive peritonitis*. The lymph is of a yellowish-grey colour, and at first very soft and easily separable, but afterwards it tends to become firmer and more adherent. It is deposited as a film, which becomes thicker by degrees, and may attain considerable thickness. Usually the exudation forms a continuous layer, though of unequal thickness, but occasionally it occurs in separate patches. It mats together loosely, or more or less firmly, the coils of intestines; and covers the solid viscera, where it tends to attain a greater thickness. The subsequent progress of this form of peritonitis in cases of recovery is towards organisation of the lymph, and the formation of thickenings, bands of adhesion, and agglutinations, which may lead to grave consequences.

In a small proportion of cases of acute peritonitis a fluid effusion constitutes the principal morbid product, varying in quantity, but it may become so abundant as to distend the peritoneum to an extreme degree. There is a little deposit of fibrinous exudation. The effusion may be mere serum, resembling dropsical fluid, and, indeed, some writers have regarded certain cases usually looked upon as those of ascites, as being really of inflammatory origin; while ascites may excite peritonitis, and thus lead to an admixture of inflammatory effusion. In other cases the fluid is sero-fibrinous, being spontaneously coagulable, and greenish-yellow, or turbid or milky; while flakes or larger fragments of lymph float in it. In this condition there is often much fibrinous deposit. If the fluid is absorbed, adhesions will subsequently form.

In the majority of cases the products tend to be of a lower type than those thus far described. The exudation is frequently soft and non-organisable, or sometimes greasy in appearance; not uncommonly it is greenish-yellow, and infiltrated with pus-cells. The fluid is also sero-purulent or actually purulent. It may be thick, laudable pus; or more liquid and unhealthy-looking; or discoloured, and more or less offensive and foul-smelling; or mixed with blood in various proportions, especially in scurvy and low fevers. The pus collects mainly in the pelvis as a rule; but collections of it are also found between the coils of intestine, and in other parts, pent up by lymph or adhesions, which look like abscesses, and may be of some size. These collections sometimes give way, and thus set up secondary peritonitis. In exceptional cases purulent peritonitis becomes chronic, and accumulations of pus burst externally or into the intestines. In rare instances a gelatinous or colloid material constitutes the effusion in peritonitis.

With regard to obvious changes presented by the peritoneum and sub-peritoneal tissue, there may be none, when the lymph is separated, the peritoneal surface being normal. In other cases it is dull, lustreless, swollen, softened, and œdematous, as well as the subserous tissue, so that the serous covering can be easily torn off from the organs. Occasionally the structures are infiltrated with actual pus; and under certain circumstances localised gangrene occurs at one or more spots.

The microscopic changes and appearances differ in the several conditions indicated, but it must suffice to state that they are similar to those observed in other forms of serous inflammation, such as transudation from the vessels; migration of corpuscles; separation of, changes in, and proliferation of the endothelial cells; proliferation of the connective-tissue corpuscles; and the formation of vascular granulations. The proportion of cells, and their vitality, differ very much in the several kinds of exudation. The changes which take place in the formation of adhesions and allied conditions are also like those noticed in other serous membranes. *See* Serous Membranes, Diseases of.

In certain forms of acute peritonitis foreign materials of different kinds are found in the peritoneal sac. Fœtid gas may be present, either from decomposition of inflammatory products, from transudation through the intestinal walls, or from perforation. The last-mentioned cause also accounts for the presence of foreign bodies, the contents of the stomach or intestine, worms, bile, gall-stones, urine, and other materials which have set up the peritonitis.

The muscles of the abdominal wall are often found more or less softened, pale, and degenerated in severe cases of peritonitis. The intestines are almost always distended with gas, in some cases to an extreme degree, so that they protrude when the abdomen is opened. Their walls are infiltrated, œdematous, and softened; and the mucous layer can be readily separated. The stomach is usually small and more or less contracted, being covered by the intestines. The liver and spleen are often pale, or discoloured to a slight depth.

The morbid appearances in acute peritonitis may be more or less *general* or *diffuse*, the whole extent of the membrane, however, being rarely involved; or *local* or *circumscribed*, the latter being due to some local irritation, and not spreading, either owing to the nature of the inflammation, or because it is prevented by adhesions. It may lead either to a local formation of lymph, as over the liver or some other organ; or to a circumscribed collection of pus, which becomes practically an abscess, and may burst in various directions according to its seat. Some local varieties of peritonitis have received special names, such as *pelvic*, *parietal*, *omental*, *hepatic*, *nephritic*, and *vesical*.

It must be remarked that special care is required in making a post-mortem examination in cases of acute peritonitis, as in many forms of the disease the products are extremely virulent, and cause dangerous or fatal septicæmia if introduced into the system in the smallest quantity. Moreover, in some forms infection is very liable to be conveyed to other persons, and extreme precautions are demanded in this matter in dealing with women in the puerperal state.

Symptoms.—The fact must be clearly recognised at the outset that the clinical history of acute peritonitis varies considerably in different cases, according to its immediate cause, the condition with which it is associated, its seat and extent, the course which the inflammation takes,

the products which it originates, and other circumstances. So far as the peritonitis is concerned, the phenomena to be anticipated are *local* and *general*. The *local* phenomena are due to the inflammation itself; to its products; and to its direct effects upon abdominal organs and structures, especially upon muscular tissues, which it first irritates and then paralyses. They may be further subdivided into *abdominal* and *thoracic*. The *general* symptoms are either of a febrile character; or depend upon the absorption of purulent or septic matters formed in the peritoneum; or are indicative of collapse. It will be expedient, in further discussing this subject, to indicate first the usual clinical course and phenomena of acute peritonitis; and then to point out the more important clinical varieties of the disease.

The *invasion* is usually distinct, being indicated by shivering or actual rigors, which may be repeated several times. If the peritonitis is due to perforation, however, the phenomena attending this lesion constitute the initial symptoms, but even here rigors not uncommonly occur subsequently. The local and general symptoms characteristic of peritonitis speedily supervene.

*Local symptoms.*—Pain is one of the most constant and striking symptoms of acute peritonitis, and it comes on very speedily, or in certain cases may even precede rigor. It depends directly on the inflamed condition of the peritoneum. As a rule it commences locally, and especially in the lower part of the abdomen, but it rapidly spreads more or less extensively, being often felt over the whole abdomen, though not uncommonly more marked in one or more spots, such as where the inflammation started from, and also in the umbilical region. This may depend upon greater intensity of the inflammation at these points. The pain is usually exceedingly severe and intense, and it may be excruciating or agonising, as evidenced in the expression of the patient's face. In character it is variously described as hot, burning, cutting, boring, shooting, darting, and so on. From time to time exacerbations are liable to occur, owing to spasmodic movements of the intestines disturbing the inflamed structures. Any movement of the body increases the suffering, so that the patient instinctively keeps the trunk at rest, and assumes a characteristic posture, so as to relieve all abdominal tension, namely, lying on the back, with the thighs and knees flexed, and the legs drawn well up. Moreover, abdominal respiration is restrained or entirely checked, as the necessary movements increase the pain; which is also aggravated by any such disturbance as the act of coughing, vomiting, or defæcation causes. At the same time there is the most exquisite tenderness, so that the patient dreads any objective examination, and cannot bear the least touch, though deeper pressure is still more unendurable. In some cases even the weight of the bed-clothes cannot be tolerated.

Prominent symptoms occur in connection with the alimentary canal. The appetite is completely lost, but there is intense thirst. The tongue is furred, and often presents a peculiar appearance, being very small, red, and irritable-looking, and soon tending to dryness. The taste is affected, and becomes bitter or otherwise disagreeable, or even disgusting. Nausea and vomiting are usually urgent symptoms, and, as a rule, set in very early. Vomiting occurs when anything whatever is taken, and even spontaneously, while there is a constant feeling of sickness. At first the vomited matters consist of mucus and altered food; subsequently they present a grass-green appearance; or under certain circumstances they may become fæculent, even quite apart from intestinal obstruction. Gaseous eructations are also common. Obstinate constipation is the rule in acute peritonitis, but exceptionally diarrhœa occurs. At first the intestinal walls are more or less spasmodically contracted, but they soon become paralysed, so that they are distended to a variable degree with gas, and this frequently culminates in extreme tympanites or meteorism. During the development of this symptom, irregular and inefficient peristaltic movements of the bowel often occur, or certain parts are more distended than others, and these conditions may be seen or felt, while they give rise to audible rumbling or gurling sounds or borborygmi. The rapidity of the distension of the abdomen will depend much upon the previous condition of the abdominal walls, as to whether they are firm or lax and yielding; and upon the rapidity with which their muscles become paralysed.

The only other notable local symptoms in the abdomen are referable to the urinary organs. The urine not only presents febrile characters, but is usually markedly diminished in quantity, and may even be suppressed. What is passed is often hot and scalding. Micturition may at first be very frequent, owing to irritation of the bladder; subsequently retention is liable to occur, owing to paralysis of this organ. The urine is not uncommonly albuminous.

Jaundice is now and then observed in cases of acute peritonitis.

The *thoracic* symptoms which may result from the local effects of acute peritonitis are hiccough, which is in many instances very distressing; the form of dyspnœa in which the respirations are very hurried—reaching 40, 50, 60, or more—shallow, superficial, and costal; sometimes cough, although the patient makes every effort to suppress it; and cardiac disturbance, the action of the heart becoming very rapid. The disorder of the respiratory and circulating functions is partly due to the general condition, but they are also locally influenced by the pain accompanying peritonitis; by its direct effects upon the diaphragm; and by the mechanical effects of gaseous or fluid accumulations upon the diaphragm and thoracic contents. Moreover, morbid conditions within the chest may be associated with peritonitis, such as pleurisy, pneumonia, or pericarditis.

*Physical signs.*—The conditions resulting from peritonitis give rise to certain physical signs, which need to be briefly indicated. It must be remembered that in this disease physical examination ought to be practised most gently and cautiously. The causes of the abnormal physical signs are the pain; the distension and other disorders of the intestines; and the presence of inflammatory products or of other materials in the

peritoneal cavity. 1. The abdomen at an early period of the case may be slightly depressed, owing to tension of the muscles, but soon becomes more or less enlarged, and often attains a great size, the skin being stretched, and the lower part of the chest also distended. Generally the enlargement is quite symmetrical, but not always. A transverse groove is sometimes visible, passing across the epigastrium. In very muscular individuals the abdomen may be but little enlarged in peritonitis. 2. There is marked absence of diaphragmatic respiratory movements, and these movements as a whole are restricted. The lower intercostal spaces do not fall in during inspiration. Very rarely a friction-fremitus may be felt in some part of the abdomen when a full breath is taken. 3. Intestinal movements are often seen or felt. 4. Palpation reveals that the abdomen is smooth and regular; at first the muscles are felt to become as it were instinctively contracted when palpation is practised; subsequently the sensation is usually that of more or less tympanitic or drum-like tension. There are exceptional cases in which it is that of fluid. 5. Percussion usually yields chiefly a more or less tympanitic sound, though not necessarily uniform in tone and pitch over the entire abdomen. The hepatic and splenic dulness are diminished or completely annulled, even though there be no gas in the peritoneum itself. A small quantity of fluid cannot be detected, or only by careful examination in certain postures (*see* Ascites), and it is usually hardly worth while in cases of peritonitis to disturb the patient for this purpose. Generally the dulness due to fluid can be elicited in dependent parts of the abdominal cavity, being as a rule distinctly movable with change of posture. It is said that the line of demarcation between the dulness and tympanitic sound is found to be zigzag when carefully percussed out, owing to the fluid getting in between the loops of intestine. In exceptional cases of acute peritonitis the dulness of fluid is the main percussion-sound noticed. Fluctuation will be present where there is fluid, but it is not a very reliable sign in acute peritonitis. 6. Auscultation, as a rule, merely reveals, if anything, sounds of the movements of flatus in the stomach and intestine; or succussion-sounds, due to the shaking up of fluid and gas in these organs. Friction-sound is for several reasons a rare phenomenon, but may occasionally be heard over some spot if the patient can be made to breathe sufficiently deeply, mainly over a solid organ, and especially the liver. 7. Examination of the chest often reveals more or less compression of the lower parts of the lungs; and displacement of the heart upwards and towards the left.

*General symptoms.*—Pyrexia usually speedily sets in in acute peritonitis, but in certain cases there is no rise of temperature throughout. While presenting considerable differences, as a rule the temperature rises markedly at an early period, and continues high for a time, though generally with remissions, having, however, no regular course. There are the usual accompaniments of fever; and the urine is markedly febrile, being concentrated, high-coloured, and depositing urates abundantly. The pulse becomes very frequent, reaching 120, 140, or even 160; it is also small, sharp, and often peculiarly hard, wiry, or thready. The increased rapidity of breathing is partly due to pyrexia. The patient soon presents an aspect of serious constitutional disturbance; the expression of the face is one of pain and grave anxiety, and the features are sunken, pinched, and withered. There is much debility or actual prostration, while at the same time the patient is generally uneasy and restless, tossing the arms about, but keeping the trunk motionless. A more or less cyanotic appearance may be evident. There are usually no prominent nervous symptoms at first, except, perhaps, headache and sleeplessness. The intellect generally remains clear to the last, and it occasionally happens that the supervention of peritonitis rouses a patient whose consciousness has been previously more or less blunted. In exceptional cases delirium or impaired consciousness are early symptoms. The further progress of the general symptoms will be indicated under the following heading.

Course and Terminations.—The large majority of cases of acute peritonitis terminate fatally, and usually within a few days, the progress being rapid. It is important to notice that the patient may feel better, and that the pain often diminishes or even subsides, sometimes suddenly, while the general condition is becoming worse and worse. The tympanites may also become less, or disappear. Sometimes before the close an abundance of dark, blood-stained fluid is discharged from the stomach and bowels, without any effort. Death may occur while the pyrexia is still high; but usually the phenomena observed become those of collapse, combined with signs of impaired respiration and stagnant circulation. The patient is greatly prostrated. The countenance assumes more and more the aspect of collapse, the eyeballs appearing sunken and surrounded with dark areolæ, the cheeks hollow, and the features markedly pinched, with blueness of the lips; the expression is that of extreme anxiety. The temperature falls, and often becomes sub-normal; the extremities are cold; and the skin is covered with clammy sweats, while the prominent parts are peculiarly cold and blue. The pulse becomes extremely rapid; feeble, sometimes to complete extinction; and irregular. The respirations are very hurried and shallow; and the voice is weak or lost. As already stated, the mind generally remains clear to the last; but in some cases the mental faculties are somewhat obscured towards the close, and delirium of a low type occurs; occasionally a comatose condition supervenes. In some instances the symptoms become those of the typhoid state.

Acute peritonitis occasionally subsides into a chronic condition, in which localised accumulations of fluid remain, and the patient lingers on, the temperature continuing elevated, but presenting irregularities. Different events may then occur, such as bursting of fluid-collections in various directions, the supervention of septicæmia or pyæmia, or general wasting and anæmia, death ultimately taking place after a variable interval.

Recovery ensues in a certain proportion of cases, where the inflammation has not been extensive, and where its products are either fibri-

nous or sero-fibrinous. Improvement is indicated by a concomitant diminution of the abdominal symptoms; restoration of the action of the bowels; sometimes an increase in the quantity of urine; a change in the aspect and expression of the patient; increased fulness and force of the pulse, and diminution of its frequency; a gradual fall of temperature; restoration of sleep; and sometimes the occurrence of perspiration. It is said that occasionally a *crisis*, with critical discharges, occurs, but this is quite exceptional, the decline of temperature being usually by *lysis*. After apparent recovery from acute peritonitis the effects of adhesions may prove serious.

Clinical Varieties.—It will only be practicable to indicate here the most striking of the clinical variations presented by cases of acute peritonitis. Two special forms are described in separate articles. *See* Puerperal Diseases; and Pelvic Peritonitis.

(*a*) **Peritonitis from Intestinal Obstruction.**—Here the symptoms of the obstruction are the most prominent, and the peritonitis only modifies them, and helps to hasten the fatal issue, which is mainly due to the intestinal condition. It is in these cases that the movements of the bowels are most evident, and the meteorism is extreme. The temperature may continue normal or even sub-normal throughout. The course is usually very rapid.

(*b*) **Perforative.**—When general, this is an intense and very fatal form of peritonitis, and usually runs its course very speedily, especially if highly irritating materials gain access into the peritoneum. Usually it is distinctly preceded by the characteristic symptoms of the perforation; or some condition is present in which a perforation may be anticipated. Therefore, if rigors occur, they follow a sudden local pain, which spreads rapidly over the abdomen. The local symptoms are extremely marked, and the vomiting is likely to be most violent, except, it is said, in those cases where the stomach itself is the seat of a large perforation. Moreover, there may be signs of gas in the peritoneal cavity (*see* **Peritoneum, Gas in**). The symptoms of collapse are evident from the first, and quickly become aggravated. The temperature is often below the normal. Should the perforation take place into a limited portion of the peritoneum, the symptoms are correspondingly limited, and less severe.

(*c*) **Adynamic or Typhoid.**—Cases of peritonitis may be thus grouped which exhibit a disposition to the rapid development of adynamic or typhoid symptoms. These may depend upon the condition with which the peritonitis is associated; or upon septicæmia or pyæmia, arising from the absorption of inflammatory products from the peritoneum. In some of these cases the local symptoms are not so evident, and may be quite latent.

(*d*) **Latent.**—This term implies that the characteristic symptoms of peritonitis are either altogether absent, or so indefinite as to be practically valueless for diagnostic purposes. Such may happen in cases belonging to the adynamic group, where the patient's consciousness is so impaired that he cannot feel pain; but even then pressure over the abdomen may bring out indications of pain, if carefully watched for. For some latent cases of acute peritonitis, of which the writer has seen a striking instance, no explanation can be given. To this class may also be referred those cases where it is really difficult to draw the line between mere ascites and peritonitis with abundant fluid effusion.

(*e*) **Infantile.**—This has been described as a variety of peritonitis. In young infants pain and tenderness in this disease are indicated by the expression, and by a short cry or whine. They do not cry loudly, on account of the pain thus caused. The abdomen is greatly distended with flatus. Vomiting is less common in children than in adults. Pyrexia is usually considerable at an early period; and the pulse becomes extremely frequent, even uncountable. Occasionally convulsions occur. The course is very rapid in young children as a rule.

(*f*) **Local or Circumscribed.**—Cases of localised peritonitis belong practically to two groups. The first includes those in which there is a limited fibrinous exudation, set up by some local irritation, especially in connection with some solid organ, such as a cancerous liver, or with a tumour. Such a condition is only indicated by a correspondingly localised pain and tenderness; with perhaps friction-fremitus and sound, elicited during the respiratory movements. The other local, as well as the general symptoms of peritonitis, are absent, and the constitution frequently does not appear to suffer in the least. In the second group a limited effusion occurs, which becomes purulent; or there may be several such effusions. Here the symptoms are more severe, but the pain and tenderness are still circumscribed, and in time external objective signs often appear in the corresponding region of the abdomen, such as limited fulness, a feeling of firmness followed by fluctuation, redness of the skin, and dulness on percussion. The more characteristic local symptoms of acute peritonitis are either absent, or much less prominent than usual. The general symptoms, however, are frequently very marked, but they are merely of a febrile character, preceded in many cases by rigors. The subsequent progress of the symptoms will depend upon the course of events. Thus, general peritonitis may be set up; the accumulation may burst externally; a communication may be formed with some internal hollow organ, especially the intestine, when gas finds its way into the space, giving rise to a limited tympanitic sound on percussion, and the fluid is evacuated by the bowel; pyæmia may occur; or the condition may become more or less chronic, and the fluid is ultimately evacuated in some direction or other, or undergoes a caseous change, or is absorbed, a cure resulting, with the formation of thickening and adhesions. Any organ in the vicinity of localised peritonitis is likely to be disturbed in its functions; and the accumulation of inflammatory products may physically interfere with neighbouring structures. Inflammation of the great omentum is attended with very marked superficial pain and tenderness.

(*g*) **Complicated.**—Clinical varieties of peritonitis not uncommonly result from its associated conditions. Thus it may be modified by some disease to which it is secondary, such as typhoid

fever or pyæmia; or it is accompanied by some other affection, such as muco-enteritis, pleurisy, or pericarditis; or the peritonitis gives rise to secondary lesions, which modify the clinical history of particular cases.

Diagnosis.—In well-marked cases the diagnosis of acute peritonitis is sufficiently obvious, as evidenced by the cause of the disease; its mode of onset; the severity and character of the local symptoms; the physical signs; the nature and gravity of the general symptoms; and the rapid progress of the case. More or less difficulty may be experienced when the peritonitis is associated with certain other conditions in the abdomen, modifying its symptoms; when it is obscured by the general state of the patient; when its symptoms are quite latent; or when the disease is local. In some instances it is impossible to distinguish between mere ascites and inflammatory effusion. It is very important to bear in mind the conditions in which latent peritonitis is liable to occur. It may happen that the diagnosis of peritonitis is clear enough, but that its cause cannot be discovered, or only after very thorough investigation.

There are certain affections which must be remembered, as being liable to simulate, and to be mistaken for, acute peritonitis. 1. The writer has seen cases of extreme tympanites, accompanied with pain, in typhoid fever, and in low febrile diseases, such as erysipelas, very much resembling some forms of peritonitis. 2. Painful conditions of the abdominal wall may prove troublesome, namely, muscular rheumatism, localised inflammation, and cutaneous hyperæsthesia. Here, however, although there is superficial and usually diffused pain, with marked tenderness, which may be extreme, there are none of the grave abdominal and general symptoms observed in peritonitis, with the peculiar pulse, and other characteristic phenomena. In connection with hysteria intense hyperæsthesia of the abdomen is occasionally met with, with more or less distension, sickness, and constipation, and even apparently severe constitutional disturbance, a combination of symptoms which may closely simulate peritonitis. Due care should, however, prevent any mistake in diagnosis, for the patient is generally obviously hysterical; no cause of peritonitis can be discovered; the hyperæsthesia is very superficial, and pressure can be borne if the patient's attention is taken off; while the general symptoms are not really those of peritonitis, and there is little or no pyrexia. 3. Painful affections within the abdomen have to be distinguished from peritonitis. These include cramp in the stomach; intestinal colic; the passage of hepatic or renal calculi; painful affections connected with the female generative organs; and perhaps neuralgia implicating certain abdominal viscera. In many cases the pain is accompanied with vomiting, frequent pulse, and considerable general disturbance, tending more or less towards collapse. The previous history of the case; the mode of onset of the symptoms; as well as their precise character, ought as a rule to render the diagnosis at once evident. Moreover, the colicky and neuralgic pains are usually relieved by pressure. Doubtful cases must be watched, when any difficulty will probably soon be cleared up. It must be remembered, however, that some of the conditions mentioned may set up local inflammation, and even peritonitis, and thus the diagnosis will be rendered more obscure. 4. Certain objective morbid conditions within the abdomen must also be alluded to in relation to the diagnosis of peritonitis. It may be impossible to distinguish between this complaint and the graver form of enteritis, especially that resulting from intestinal obstruction, but the diagnosis is not of practical moment, and the two diseases are usually combined sooner or later. The positive diagnosis of peritonitis in some cases of perforation may also be impracticable. In the local forms of inflammation commencing in cellular tissue, such as perinephritis and perityphlitis, it cannot be certainly known whether the peritoneum is involved or not; but it may be assumed that the neighbouring portion of the membrane is very soon implicated, and the peritonitis may become general. Possibly, circumstances might arise under which accumulations of fluid, such as an ovarian cyst, a hydatid cyst, or a distended bladder, might simulate peritonitis with effusion, but there rarely ought to be any real difficulty in these cases. These conditions, as well as other tumours, may, however, set up peritonitis. 5. It must be mentioned that at first acute pleurisy or pneumonia may simulate peritonitis, the pain present in these diseases being referred to the upper part of the abdomen, or even to a more extensive area, and being accompanied with tenderness. It may be that in some of these cases the peritoneum is locally inflamed.

Prognosis.—Acute peritonitis must always be regarded as a serious disease, and in many cases the prognosis is extremely grave, or even hopeless. Moreover, its progress, when general, is usually very rapid, so that the patient may die within thirty-six or forty-eight hours, and generally succumbs within a week. Death may occur, however, in three or four weeks, or even at a later period. In some of the cases of very short duration, death is due rather to the cause of the peritonitis, such as intestinal obstruction or perforation, than to the disease itself. The indications giving hope of recovery have already been pointed out, but the practitioner must guard against being misled into giving a hopeful prognosis from mere improvement in the subjective feelings of the patient, without any corresponding amelioration in the objective local symptoms, and in the general condition. Even in cases where recovery takes place, the effects of adhesions and other remaining morbid conditions must be borne in mind, as these may subsequently become troublesome or even dangerous.

The prognosis of acute peritonitis will be materially influenced by the following considerations:—1. *Its ætiology.*—The most grave forms are those due to perforation; and those of septic origin, especially puerperal peritonitis. That associated with Bright's disease and other forms of blood-poisoning, is also very serious. When the disease arises from direct injury, or from some local irritation, the prognosis is much more hopeful. 2. *The patient.*—In young infants peritonitis is absolutely fatal, and it is extremely grave in children generally. A weak or low condition

of the patient, from bad living, intemperance, previous illness, or other causes, renders the prognosis more serious. 3. *The extent, rapidity, and precise nature of the disease.*—Peritonitis is more serious in proportion to its extent, and when it is local the result is much more hopeful, especially if the products of the inflammation seem to be merely lymph or sero-fibrinous fluid, when no particular danger need be anticipated. If the course of the disease is very rapid, the prognosis is exceedingly grave, partly because the inflammatory products are then probably of a low type. When peritonitis shows any tendency to become chronic, there is more hope; but even then a fatal issue may ultimately occur from various causes. 4. *The symptoms.*—It may be stated generally that the more severe the symptoms of peritonitis are as a whole, the more dangerous is the case. Among the chief indications of special danger may be mentioned extreme tympanites; urgent vomiting; the passage of bloody fluid from the stomach or bowels; great dyspnœa; incessant hiccup; very high fever; rapid development of signs of collapse; typhoid symptoms, with low nervous phenomena; and an extremely rapid, feeble, and irregular pulse. 5. *Complications.*—These may increase the gravity of a case of peritonitis, such as pleurisy, pneumonia, or pericarditis.

Treatment.—It will be evident that no uniform plan of treatment can be applicable to all cases of peritonitis, and much judgment and consideration on the part of the practitioner are often needed in the management of this serious disease. There are, however, certain definite indications to be recognised, which will now be pointed out, as well as the principal means by which they should be carried out.

*a.* Attention must, in the first place, be directed to the cause of the peritonitis, which in obscure cases should be carefully sought for, and, if possible, got rid of, or mitigated. This may be illustrated by an accumulation of fæces, hernia, and other forms of intestinal obstruction. In most cases, however, this indication cannot be fulfilled; but even then attention must be directed to the cause.

*b.* The next indication is to endeavour to combat the inflammation itself, so as to arrest or subdue it, to influence its products, and to obviate its injurious effects upon the abdominal organs. Rest for the affected structures is most important, so far as it can be obtained. It will rarely be necessary to enjoin rest for the abdomen generally, and relaxation of its muscles, as the patient will instinctively attend to this. It may be desirable to raise the bed-clothes from the body, by means of a cradle or other suitable apparatus, so as to prevent all irritation from this source. If not otherwise indicated, it is extremely important in early cases of peritonitis to give as little as possible in the way of food. Only fragments of ice, or small quantities of iced drinks should be allowed, or iced milk or beef-tea, if they can be retained. Not uncommonly the stomach rejects everything, and then recourse may be had to small enemata, and it might be useful to employ artificially-digested aliments in this way, according to the plan of Dr. William Roberts.

Abstraction of blood, either by venesection or by the application of leeches to the abdomen, is a common practice in acute peritonitis. If this measure is thought desirable, it is certainly preferable to remove the blood locally; from ten to thirty leeches may be applied in different cases, but it certainly can never serve any useful purpose to put on a larger number than this, and would probably be followed by untoward results. Removal of blood can only be of service in the early stage of the disease, and is decidedly injurious when the inflammatory process has progressed considerably, and especially if it has advanced rapidly. Moreover, it must not be practised in low forms of peritonitis, or if the patient is badly nourished and weak from any cause. Healthy, strong, and plethoric subjects are most likely to be benefited by removal of blood. This measure is also likely to be useful in some forms of local peritonitis.

The chief medicines which are employed for their immediate effects upon peritonitis are calomel and opium, and they are usually given in combination, in the form of pill, every two to four hours. The calomel is administered until the system is brought under the influence of mercury; or, in the case of infants, this is sometimes effected by inunction with the mercurial ointment. In the writer's opinion, mercurialisation as a routine plan of treatment in peritonitis is to be strongly deprecated, and he has never seen any good result from its employment. Opium, however, is a remedy of extreme value, and is often our sheet-anchor. Amongst other beneficial effects, it acts upon the stomach and bowels, being generally supposed to arrest peristaltic action in the latter, though some are of opinion that it excites peristaltic action, but diminishes reflex irritation. In whatever way this drug acts, its beneficial effects upon these organs are very manifest. Opium is usually given in the form of pill, containing from gr. $\frac{1}{2}$ to gr. ij of the powder, and repeated every two to four hours. It is remarkably tolerated in acute peritonitis, unless there be renal disease, when it must be given very cautiously, or not at all. In children it must also be administered with due care. If the stomach is extremely irritable, tincture of opium may be administered in the form of enema; or, which is preferable, morphia may be substituted, especially by subcutaneous injection; and this may be also employed as an adjunct to the internal exhibition of opium, if the pain should be very intense. Tincture of aconite, veratrum viride, and digitalis have been employed for their effects on inflammation in the early stages of acute peritonitis, but they cannot be recommended.

The question of local applications to the abdomen, as regards their immediate effects upon peritonitis, is important, and by no means decided. The common practice is in favour of employing hot applications, in the form of light poultices or fomentations, to which anodynes may be added; or turpentine stupes or sinapisms. The use of cold has, however, been strongly advocated by many authorities in the early stage of peritonitis, and deserves a more extended and thorough trial than it has hitherto received. It may be employed either by means of cold compresses, frequently changed; a bladder containing pounded

ice, not too heavy; or flannel dipped in iced-water. The effects claimed for this treatment are that it contracts the vessels; allays nervous irritability, and consequently intestinal disturbance; and alleviates pain. The sensations of the patient must be some guide as to its continuance. At a later period hot applications are decidedly to be preferred, as the cold applications can be of no service, and will probably prove injurious.

As certain cases advance, it may be advisable to apply blisters to different parts of the abdomen, with the view of promoting the absorption of inflammatory products. Operative interference is decidedly indicated in some cases of considerable effusion, the fluid being removed by a trochar. It may also become a question whether purulent collections should not be let out, after acute symptoms have subsided. Certainly this measure is indicated if there is any local accumulation of pus.

*c.* The general condition of the patient in cases of acute peritonitis always demands constant attention, and in many instances it is the chief matter for consideration. Whenever any tendency to collapse or adynamia sets in, alcoholic stimulants are called for, in variable quantity according to circumstances, brandy and champagne being the most suitable. Their administration must not be left until too late a period. They are best given at frequent intervals in small quantities. If stimulants cannot be borne by the stomach, brandy should be given in enemata. Liquid nourishing food is also often required in large quantities, and may be administered in the same way. Quinine in full doses, ether, musk, camphor, ammonia, bark, and turpentine, are the chief medicines which may be called for in bad cases, to combat the general symptoms. Subcutaneous injection of ether or camphor may be of service in extreme conditions.

*d.* Symptoms often call for special treatment in acute peritonitis, although most of them tend to be alleviated by the measures already considered. It will only be necessary to allude further to the following. Nausea and vomiting may call for small doses of iced effervescents, with hydrocyanic acid and morphia; soda-water and milk; or drop-doses of creasote. Constipation in many cases ought on no account to be disturbed; if any treatment is indicated, calomel at first, followed by enemata, will answer the purpose. Excessive diarrhœa in certain cases may require to be checked by enemata containing laudanum. Meteorism is sometimes relieved by calomel; if very troublesome, the use of enemata containing turpentine, the passage of a long tube *per rectum*, or, in extreme cases, the puncture of the distended intestines in several places with a fine trochar, are the measures indicated. The relief of this symptom is the only direct way of influencing dyspnœa. Hiccup calls for narcotics, ether, the local application of sinapisms or blisters, and, if dangerous, inhalation of chloroform.

*e.* In cases where recovery ensues, much care is required during convalescence, as regards diet and general management; and the absorption of morbid products may be aided by applying blisters or iodine to the abdomen, and by baths and other measures.

2. **Peritoneum, Chronic Inflammation of.** Synon.: Chronic Peritonitis.—This affection, like the acute form, may involve the peritoneum more or less generally; or only over a localised and limited area. The conditions included under the term are somewhat indefinite, but not uncommonly they are well-marked pathologically, as well as of considerable clinical importance.

Ætiology and Pathology.—Without entering into details, it must suffice to point out the circumstances under which chronic peritonitis may occur:—1. There is no doubt as to its being a sequel of one or more attacks of acute peritonitis in some instances, either general or local, but especially the latter; and after a circumscribed acute peritonitis the chronic affection may spread more or less generally. Moreover, the conditions remaining after acute peritonitis are liable to set up further mischief in a chronic manner. 2. Chronic peritonitis may become associated with ascites, but more particularly when repeated paracentesis has been performed for the relief or cure of this condition. 3. Localised chronic peritonitis is very common as the result of continued irritation, set up by some diseased organ, such as a cirrhotic or cancerous liver, cancer or chronic ulcer of the stomach, old hernias, tumours, and various other obvious conditions. There are, however, cases occasionally observed in which the cause is not so evident, and these have been referred to irritation by accumulations of fæces, or to repeated pressure or other mechanical causes acting from without. 4. Morbid formations in the peritoneum itself are very liable to set up chronic inflammation. Of these the principal are tubercle and cancer, and tubercular and cancerous peritonitis constitute important forms of this disease. 5. In rare instances a chronic inflammatory effusion collects in the peritoneal cavity, without any obvious cause. This cannot be separated by any marked line of demarcation from some latent cases of acute effusion. The fluid may be actually purulent under these circumstances, but is generally serous, and cannot be distinguished from that of mere ascites. This chronic effusion has been noticed during convalescence from fevers; and has also been attributed to cold and wet. It may be mentioned here that some cases of chronic peritonitis have also been referred to chronic renal disease, and to rheumatism.

Anatomical Characters.—The precise conditions present in an individual case of chronic peritonitis are subject to great variety, as regards their nature, extent, and site; but their general characters can be readily indicated.

Adhesions or thickenings connected with the serous membrane are almost constantly present in different degrees, and not unfrequently they constitute the sole anatomical evidences of chronic peritonitis. They result from the development of the inflammatory products, and the formation of connective or fibrous tissue, with new vessels. The thickening varies much in degree, ranging from what is scarcely perceptible, to the production of a dense fibrous mass, an inch or more in thickness, as the writer has seen. It may be evident in the parietal peritoneum; around organs, forming more or less thick and firm capsules; or in the peritoneal folds, especially the omentum

and mesentery. Adhesions or agglutinations also form between different parts, thus uniting organs to each other, to the abdominal walls, or to the mesentery or omentum; or sometimes matting the whole together into an inseparable or indistinguishable mass. They present great variety, and by the movements which take place within the abdomen, they may be stretched or made more loose, or even be got rid of altogether in some instances, when they have formed after an acute attack. On the other hand, in many cases the adhesions and thickenings tend to become gradually stronger and denser, and at the same time to undergo contraction, so that they produce serious effects.

In many cases of chronic peritonitis effusion of some kind is observed. It may be merely serous, or containing fibrinous flakes, sero-purulent, or actually purulent. Blood may also be present in it. Occasionally this is the prominent or only anatomical change; and the fluid may range in quantity from a small to an enormous amount. Usually it is associated with the other conditions already described, so that the fluid is not free to move about, and may be actually circumscribed, or even lie in the substance of great thickenings. Purulent accumulations are likely to make their way in various directions, either outwards or into internal parts.

When chronic peritonitis depends upon the presence of tubercle, cancer, or other morbid formations, these will be evident on *post-mortem* examination. Moreover, the inflammatory products may undergo degenerative processes, and hence caseous or cretaceous particles or masses be found. It is highly probable that tubercle may be formed secondarily, as the result of infection from caseous or purulent collections. Pigment is also often present in abundance.

It is important to notice the obvious effects liable to be produced upon the abdominal organs and other structures by chronic peritonitis. They are fixed by the adhesions and thickenings, and may be displaced at the same time. Compression or constriction is often produced, especially important in the case of hollow viscera, as well as distortion, twisting or torsion, and incarceration. Some of these effects may occur acutely in connection with bands of adhesion, thus giving rise to grave consequences; and fixation of the bowel may also lead to intussusception. The omentum may be greatly distorted, or fixed in some abnormal situation; while the mesentery has been found extremely shortened, so as to contract the small intestine to half its length, its serous covering and longitudinal muscular layer being shrivelled, and its mucous lining thrown into transverse folds. The deeper tissues of some of the abdominal viscera are likely to be affected by long-continued chronic peritonitis; and atrophy from compression may ensue. As one good result of this condition, mention must be made of the fact that it is not uncommonly the means of preventing or modifying the injurious consequences resulting from some forms of perforation of abdominal viscera, by giving rise to previous adhesions and thickenings, and thus obviating the escape of their contents, or limiting their dissemination.

Symptoms.—The clinical history of chronic peritonitis necessarily presents much diversity. The phenomena observed result from the mere presence of the inflammatory products; the effects produced upon the organs within the abdomen by these products, whether in the way of mere functional disorder, or other more obvious derangements; the consequences of direct pressure upon tubes, vessels, or other structures; and the general or constitutional disturbance often present.

According to its mode of origin, chronic peritonitis either remains after an acute illness, or after a succession of more or less acute attacks or exacerbations; or its onset is gradual and chronic from the first, and may be very insidious. Of slight adhesions left after acute peritonitis, or originating from chronic causes, there are often no clinical signs; or there may be uneasiness and discomfort, or even painful sensations at times in some part of the abdomen, especially the iliac region, with a tendency to intestinal disorder, in the way of spasmodic movements and constipation. Even when there are no symptoms whatever, adhesions may at any time cause serious consequences. In well-marked cases of chronic peritonitis the symptoms to be expected are of the following nature:—Abnormal subjective sensations are usually experienced in the abdomen, such as tightness, fulness, dragging, or actual pain. The pain, when present, is of a dull character, not severe, and liable to come and go, or to present exacerbations from time to time; it is often localised, and especially if the peritonitis be circumscribed; sometimes there is a feeling of local soreness or heat. The painful sensations tend to be increased by movement, and by shaking the body. They are sometimes aggravated by posture, in some cases by bending forwards, in others by the erect posture; and they may be increased by going up stairs, especially if the abdomen is distended. More or less tenderness on pressure is very common, even when there is no spontaneous pain, but not invariable; it is frequently more evident at certain spots, where it may be considerable. Colicky pains are not uncommon in chronic peritonitis, and may occur in severe paroxysms, especially after food, being due to the disturbed action of the bowels, associated with the formation and movements of flatus, which may be abundant, even amounting to tympanites. Appetite is often impaired or variable; and dyspeptic symptoms are frequent. Constipation is the rule, and may be very obstinate, even amounting to obstruction under certain conditions. Sometimes diarrhœa is present, or it may supervene at times, and occasionally assumes a dysenteric character. This symptom is very common in tubercular peritonitis, in consequence of the bowel being the seat of ulceration. In some cases vomiting occurs from time to time. When there is considerable effusion in the peritoneum, the secretion of urine is diminished. Respiration may be mechanically interfered with from the same cause. As the result of pressure by thickenings and other conditions upon different structures, jaundice, ascites, œdema of the legs, thrombosis, albuminuria, or neuralgic pains may supervene. When the organs are all matted together, their entire functions must be more or less interfered with.

General symptoms are usually present in va-

rious degrees in cases of chronic peritonitis, but in many instances they depend mainly upon the condition with which this disease is associated, especially tuberculosis, though they may also be produced by the peritonitis. These symptoms include pyrexia, not high, and having no regular course, but presenting exacerbations, either persistent or occurring at intervals, and in some cases assuming a hectic character; increased frequency of the pulse; a sense of languor or weakness; and more or less general wasting and anæmia, with dryness and harshness of the skin.

It must be noted that in some cases of chronic peritonitis, even where there is considerable effusion, the local and general symptoms are very slight and indefinite, and the patient only suffers from the discomfort due to the accumulation of fluid. On the other hand the progress is not uncommonly from bad to worse, ending in extreme emaciation and exhaustion, with the formation of bed-sores; or there may be a succession of improvements and relapses; while various phenomena result from the opening of collections of pus in different directions. Thus death may gradually or rapidly terminate a case; or pyæmia may supervene. Even in bad cases, however, comparative recovery may ensue, only the effects of the inflammation remaining, and being more or less troublesome.

Physical Signs. — These require separate notice, and they may be the only clinical indications of chronic peritonitis. They necessarily differ in detail according to the nature of the abnormal physical conditions present in the abdomen, and they are also liable to alter during the progress of a case; but their general characters are sufficiently clear. 1. In general chronic peritonitis enlargement of the abdomen is observed, mainly in proportion to the amount of fluid present; but it depends partly on gas in the intestines, or sometimes on solid exudation. As a rule it is not very considerable, but the abdomen may attain an enormous size, with stretching of the skin and other accompanying phenomena. While regular in shape on the whole, it may present more or less want of symmetry, especially after a time. On the other hand, in some cases the abdomen becomes locally or generally retracted, and may then exhibit marked irregularities. 2. The sensations on palpation are very variable, but often highly characteristic. It may happen that there is a uniform feeling of fluid. More commonly the sensations are not uniform, but differ in different parts of the abdomen, including indistinct fluctuation in localised areas, sometimes very limited and in unusual situations; with firmness or resistance around or in other parts, ill-defined, occasionally nodulated; and even distinct tumours may be felt, more or less irregular. These in some instances are due to morbid growths, such as cancer, but they also originate in organised inflammatory products. Under certain conditions the abdomen yields a peculiar feeling of being movable as a whole. Movements of the bowels are sometimes recognised. When there are localised adhesions between the visceral and parietal peritoneum, if pressure is made at a little distance from the seat of adhesion, a fold of the skin will appear where this adhesion exists. Possibly general adhesions might be made out by palpation. 3. Percussion occasionally reveals freely movable fluid. As a rule, however, it shows that the fluid is not freely movable, or that it is actually loculated irregularly, this condition being associated with more or less solid material. Hence there is extensive and diffused dulness, which may be noticed mainly in front, and not in dependent parts. Not uncommonly patches of dulness and tympanitic resonance are found contiguous to each other, and irregularly distributed, unaffected by posture. Over the fluid fluctuation may, perhaps, be elicited, but indistinctly; and where there is much solid the sensation on percussion is that of resistance. 4. Friction-fremitus and -sound are sometimes present. 5. Changes of posture, as a rule, produce comparatively little or no effect upon the shape of the abdomen, the sensations, or the percussion-sounds.

When chronic peritonitis is localised, it may be practicable to detect the condition by palpation and percussion. Moreover, when organs become fixed by peritoneal adhesions, especially if they are diseased at the same time, this state of things may often be recognised by noticing that the affected organ does not present its normal mobility in relation to manipulation and respiratory movements.

Diagnosis.—In most instances chronic peritonitis, if of any extent, can be recognised without much difficulty, by attending to the history of the case, the symptoms, and the physical signs. It may be very difficult, or even impossible, to distinguish positively between mere ascites and chronic inflammatory effusion. All the circumstances of the case must be taken into consideration; and in doubtful cases the removal of some of the fluid, by means of a small trochar, will aid the diagnosis materially. It is important to determine the cause of chronic peritonitis, when present, and especially whether it is simple or tubercular. Here, again, the whole case must be considered, not forgetting the age of the patient, the family history, the condition of the main organs, and other points. Tubercular disease in other parts may, however, be accompanied with simple peritonitis. It has been said that a hæmorrhagic character of any fluid removed is significant of tubercular peritonitis, but this certainly cannot be relied upon; and the same remark applies to the occurrence of redness and œdema about the umbilicus, which has been supposed to be diagnostic of the tubercular disease.

It is quite impossible to diagnose with certainty obscure cases of localised chronic peritonitis; and it may become very difficult, even in evident cases, to determine the precise conditions within the abdomen.

Prognosis.—The prognosis of each case of chronic peritonitis must be considered on its own merits, as regards the cause of the disease; its extent and products; the progress of the morbid changes; the effects produced on the abdominal organs; and the general symptoms. Some cases are of little or no consequence; others are very serious; but even in apparently serious cases great improvement, or even practical recovery, may take place. The dangers to be feared from the opening of purulent collections in various

directions must be borne in mind; and also those liable to arise from the presence of bands of adhesion within the abdominal cavity. Tubercular and carcinomatous peritonitis are necessarily very grave forms of the disease, but the former may certainly be recovered from.

Treatment.—With regard to the *local* conditions in chronic peritonitis, it is often desirable to endeavour to promote the removal of morbid products within the abdomen. For this purpose it may be important to keep the patient entirely at rest in bed for a time. The internal administration of iodide of potassium or syrup of iodide of iron may be tried; and in some instances diuretics might be of use. Possibly the careful employment of some mercurial preparation would be serviceable in appropriate cases. Violent purgation is to be deprecated; but where there is much fluid, advantage might be derived from repeated diaphoresis, induced by means of the hot-air, vapour, or Turkish bath, or by the use of jaborandi. Local measures are in some instances of essential service, namely, counter-irritation, especially by the application of iodine; friction with some oil or ointment; and pressure. The writer has found pressure decidedly valuable in aiding absorption in certain cases, as well as in giving support, the abdomen being covered with cotton-wool, and a suitable bandage applied more or less firmly. A flannel bandage answers best. In cases of large effusion, where absorption cannot be effected, the writer has no hesitation in recommending paracentesis, even repeated when required, having seen signal benefit follow this treatment. A localised purulent accumulation must be treated on general principles.

General treatment is often of essential value in cases of chronic peritonitis. It is directed to the condition upon which the disease depends, such as tuberculosis, or to its effects, but the measures are similar in the main, consisting of good nutritious diet, suitable sanitary conditions, change of air, and the administration of cod-liver oil, quinine, preparations of iron, and other tonics and nutrients. Wine may often be given with advantage.

Symptoms will probably need attention from time to time, such as pain, flatulence, dyspeptic symptoms, constipation, diarrhœa, and various others. The organs generally must be looked to, and their functions promoted. A free flow of urine often follows absorption of fluid, or its removal by operation.

There are many cases of chronic peritonitis which need no special treatment, especially when it has merely caused local changes.

3. **Peritoneum, Gas in.**—Synon.: Pneumoperitoneum; *Tympanites peritonei.*

Gas may be present in the peritoneal cavity from three causes, namely:—1. Its escape from the alimentary canal through some abdominal communication; 2. Transudation of gas through the intestinal wall; 3. Decomposition of materials in the peritoneal sac. The gas may be generally diffused; or limited by adhesions. The condition cannot be said to give rise to any definite symptoms, but it may increase abdominal distension and discomfort. When general it might be recognised by the following *physical signs*:—1. There is extreme and uniform distension of the abdomen, with a specially prominent epigastrium as the patient lies on his back. Sometimes doughy fluctuation is felt in the epigastric region, with a peculiar pitting on pressure. 2. The percussion-sound is markedly tympanitic or even metallic, full and deep in tone; and this sound is very extensive, completely annulling the anterior hepatic and splenic dulness. 3. Succussion-sensations and sounds may be produced, owing to the presence of gas and fluid in the peritoneal sac. These are more uniformly and extensively diffused than when such phenomena arise from similar conditions in the stomach or intestines. The aortic sound may also have a diffused metallic quality over the abdomen. A local collection of gas might cause a corresponding fulness of the abdomen, and yield a localised tympanitic or metallic percussion-sound, as well as succussion phenomena.

4. **Peritoneum, Dropsy of.**—*See* Ascites.

5. **Peritoneum, Hæmorrhage into.**—Blood may escape in quantity into the peritoneal cavity as the result of injury; or from the rupture or perforation of different structures within the abdomen. An important form of hæmorrhage is that which results from the rupture of an aneurism. More or less blood may be present in inflammatory or dropsical effusion; or it may originate in the opening of vessels by morbid growths, or the spontaneous rupture of new vessels. Hæmorrhage is not uncommon in connection with tubercle. It may also occur from scurvy or purpura.

Symptoms.—It might possibly happen that peritoneal hæmorrhage could be recognised, if there were some evident cause for this condition; followed by the physical signs of the presence of blood in the peritoneal cavity; and general indications of loss of blood. As a rule, however, the condition cannot be detected. The hæmorrhagic nature of an effusion can only be recognised by withdrawing it.

Treatment.—This merely consists in the local and general treatment for loss of blood, if anything can be done or is required.

6. **Peritoneum, Injuries to.**—The peritoneum is liable to be injured from without by contusions and wounds of various kinds; and from within by perforations and ruptures, the injury being aggravated in many cases of this kind by the introduction of matters into the peritoneal cavity, causing mechanical or chemical mischief, such as gases, food, fæces, calculi, bile, urine, pus, or worms. The mere injury to the serous membrane itself cannot be said to produce any evident phenomena, unless it be extensive; but it leads usually to serious effects, which have already been considered—namely, hæmorrhage, which may be on a large or fatal scale; and acute inflammation of an aggravated type. Of course it must be remembered that along with the injury to the peritoneum, there is usually associated some more or less severe injury to an abdominal organ or other structure, and the phenomena resulting therefrom will be present.

**7. Peritoneum, Morbid Formations and New Growths in.**—These require brief notice, and may be considered in the following order:—

*a.* It is necessary to call attention to the fact that the sub-peritoneal tissue, especially that of the peritoneal folds, becomes in obese persons the seat of a large deposit of fat, an overgrowth of that normally present, and this is particularly noticed in the omentum. As a consequence the functions of the alimentary canal are unquestionably liable to be interfered with, and various dyspeptic symptoms, flatulence, and constipation may arise. Moreover, this condition assists in producing enlargement of the abdomen; and in muffling the natural tympanitic sound. It can be recognised at once by the appearance of the patient; but it is important to remember that it may conceal some other morbid condition within the abdomen. The treatment is that for obesity generally (*see* OBESITY). In very exceptional instances distinct fatty tumours have occurred in connection with the peritoneum; and these may become separated by constriction of their attachments.

*b. Tubercle* is the most common and important new growth in connection with the peritoneum. It occurs in three classes of cases, namely—(1) as a part of general acute tuberculosis, the tubercle appearing in the peritoneum as a diffuse miliary deposit, presenting the usual characters; (2) in connection with tubercular ulcers in the intestines, localised granulations forming on the corresponding surface of the peritoneum; (3) as an independent disease, usually assuming a more or less chronic course, and accompanied with inflammatory changes. This form is usually secondary to, and associated with, similar changes elsewhere, especially pulmonary phthisis; but it is occasionally primary, and may exist for a time or throughout alone, as the result of infection from caseous glands, from products remaining after peritonitis, from caseous deposits in the epididymis, or from other sources, or exceptionally without any obvious cause. This disease occurs mainly in young persons, but is rare under four years of age.

ANATOMICAL CHARACTERS.—The morbid conditions found on *post-mortem* examination in cases belonging to the third group, consist of a combination of disseminated tubercles in different stages, with signs of chronic peritonitis. Sometimes the tubercle has entirely undergone caseous changes. As the result of the peritonitis, great thickening and extensive adhesions are usually present, with much contraction. Hence the omentum is often drawn up into a firm mass across the upper part of the abdomen; and the mesentery is also contracted, drawing the intestines together, and distorting them. More or less effusion is almost always present, which generally contains altered blood in variable quantity. Sometimes abundant hæmorrhage takes place into the peritoneum. Morbid changes, either of a tubercular character, or resulting from this disease, are usually found in other parts of the body.

SYMPTOMS.—The clinical phenomena present considerable variety in different cases, as regards their nature and progress. In some instances tubercular disease of the peritoneum begins acutely, or in a succession of acute attacks, usually circumscribed, with symptoms like those of peritonitis, then subsiding into a chronic condition. Far more commonly the progress is very chronic and insidious, or latent, ending in signs of effusion. In other cases there are marked remissions of the symptoms during their progress, both local and general. The phenomena may be summarised as those of the peritoneal inflammation; with general symptoms of tuberculosis; and often signs of implication of important organs in the morbid condition. When the peritoneal disease is secondary, it can be readily recognised. The course of the disease is usually chronic; and as a rule it terminates in death, but not invariably.

TREATMENT.—The treatment for tubercular disease of the peritoneum is that of the general disease; with that suitable for chronic peritonitis.

*c. Cancer* is comparatively rare in the peritoneum. It is by far most commonly secondary, originating from extension, or as a distinct secondary formation; and especially following malignant disease of the alimentary canal, liver, retro-peritoneal glands, and sexual organs. Rarely this disease is primary, and has then been referred to injury in some instances. It occurs almost always after middle life, but has been met with in children.

Peritoneal cancer generally occurs in the scirrhous form, but is occasionally encephaloid, melanotic, or colloid, the last being comparatively frequently found in the omentum, and it may form an enormous growth. Rarely the disease assumes an acute character, the cancer being in diffused nodules. Usually chronic, it either takes the form of separate nodular masses, which may become depressed; or of an infiltration, sometimes of great thickness. Generally there are associated signs of chronic peritonitis, with more or less effusion, which may be hæmorrhagic; extensive hæmorrhages sometimes take place. Abdominal organs are often found implicated; or the cancerous process may lead to their destruction or perforation. In some instances there is large dropsical effusion in the peritoneal cavity.

Cancer of the peritoneum may be usually recognised clinically when it occurs as a secondary event, but even then its diagnosis is not always clear. As a primary disease it is generally difficult to detect. The phenomena include the physical signs of the morbid growth, especially as revealed by palpation and percussion; the signs of ascites or chronic peritonitis; disturbance of the abdominal organs; the general symptoms and cachexia of cancer; and the evidence of the existence of the disease in other parts. Pain is a common symptom, and is usually paroxysmal, being due to the cancer itself, as well as to other causes; tenderness is also marked. The cancerous nodules may originate friction-sound. The course of the disease is occasionally acute, with pyrexia; as a rule it is chronic, with little or no fever, or this only occurs at intervals. Hæmorrhage may cause marked anæmia or fainting. The cancerous masses may also originate pressure-symptoms. This disease is necessarily fatal; and treatment can only be symptomatic.

With regard to colloid of the omentum, it is desirable to notice specially its physical signs:—

1. The abdomen may be greatly enlarged, but is not uniform or quite symmetrical; the umbilicus is only stretched, not everted. 2. Palpation generally reveals firm, irregular masses. If present, fluctuation is very indistinct. 3. The anterior regions of the abdomen are dull extensively. 4. Usually a change of posture produces little or no effect upon the physical signs. 5. A slimy, gelatinous fluid may be removed by the exploratory needle or aspirator; and occasionally a similar fluid is said to be discharged *per rectum*, or from the stomach.

*d.* Among rare formations found in the peritoneum may be mentioned hydatids, associated or not with a similar disease in one or more organs; serous, dermoid, and colloid cysts; fibromata; myxomata; and remains of blood-clots.

8. **Peritoneum, Malformations of.** — It will suffice to mention under this head that the folds of the peritoneum, such as the mesentery, may be abnormal in length or formation; that unusual bands or openings may be present; and that prolongations of the peritoneum, which naturally become obliterated or shut out from the general cavity, sometimes do not undergo these changes, as may be illustrated by the occasional patency of the process which descends with the testis into the scrotum. As the result of these abnormalities displacements of organs may occur; or their movements are restricted or too free; or constriction of the intestine may take place. These conditions can only be recognised clinically by their effects; and not uncommonly they cannot be made out. Treatment may sometimes be directed to their cure, as is exemplified in the radical cure of a congenital hernia.

FREDERICK T. ROBERTS.

**PERITYPHLITIS** (περί, around, and τυφλόν, the cæcum).—SYNON.: Fr. *Périty phlite*; *Phlegmon iliaque*; Ger. *Perityphlitis.*

DEFINITION.—Inflammation of the connective tissue behind and around the cæcum.

ÆTIOLOGY.—The most frequent cause of this not uncommon affection is an extension of inflammation from the cæcum or the vermiform appendix, more especially if the typhlitis caused by accumulation of fæces or by some foreign substance, such as fish-bones or cherry-stones, has proceeded to ulceration. The anatomical relations of the cæcum in the right iliac fossa are favourable to such a result.

Owing to the continuity of the sub-peritoneal connective tissue, it is obvious that inflammation and suppuration in regions somewhat distant from the iliac fossa may also extend into that locality. Perinephritic and psoas abscesses may therefore become causes of perityphlitis.

External injury, such as blows, kicks, or severe compressions, as between the buffers of a train, may induce inflammation of both bowel and surrounding tissues, so that it becomes impossible to say whether the cæcum or the connective tissue becomes first affected.

Occasionally suppuration in this region may result from septicæmia; and exceptional cases occur where no cause can be assigned beyond cold. *See* CÆCUM, Diseases of.

ANATOMICAL CHARACTERS.—Perityphlitis runs a somewhat variable course. In one set of cases the progress may be acute, marked by active suppuration, and leading to the formation of an abscess in the iliac fossa behind the cæcum. Such an abscess may extend to a considerable distance in the sub-peritoneal tissue, upwards, towards the spine, or downwards into the pelvis; it may open into the peritoneal cavity or the bowel; or point outwards in the abdominal wall, or downwards through the pelvis. The contents of the abscess are usually extremely fœtid, and a putrid destruction of the adjacent tissues, especially the muscular, is frequent. The nerve-trunks of the lumbar plexus escape this, but the large veins—iliac, ileo-colic, &c.—are blocked with coagula.

More frequently, however, the disease is of a chronic and insidious character, often presenting obscure symptoms preventing the real nature of the case from being ascertained; and it may thus last for many months. The inflammatory process leads then to a considerable thickening of the connective tissue, of a tough fibrous variety, rather than to the formation of pus. If the starting-point have been a perforating ulcer of the cæcum or appendix, the bowel may be found to be firmly imbedded in a mass of tough fibrous tissue, which binds it down closely to the iliac fossa and to the abdominal wall, penetrating the muscular tissue and extending even to the bone. Excavated in this new-formed material are numerous irregular shaggy loculi, communicating with one another, and to a variable extent with the gut, thereby allowing extravasation of the fæces, though this may be to only a slight degree. Sometimes the intestine may be so much involved and destroyed that its course cannot be distinctly traced, and the path of the bowel-contents is then, for a certain distance, limited by these new-formed irregular channels. This condition may last for a long time, and death may result from exhaustion rather than from any distinct lesion, such as peritonitis. Not infrequently, however, an acute attack of suppuration may supervene in this state, and give rise to an abscess which may take one of the courses indicated above. Or when even perforation of the bowel has been the cause, the aperture may subsequently become closed up; and, as in the cases where the inflammation has started outside the cæcum, the surrounding connective tissue becomes much thickened and indurated, and, by partly involving the intestine in its contraction, produces obstruction in the canal. The writer has noticed a marked tendency to the deposition of pigment in the new-formed tissue in such cases.

SYMPTOMS AND SIGNS.—These will to a certain degree depend, especially at the outset, upon the nature of the attack, and the extent to which the cæcum is involved. If the symptoms of typhlitis be much prolonged, or if in addition to the signs of that disease, an examination should reveal the existence of a swelling deeply seated behind the cæcum, then we may suspect that the inflammation has extended beyond the gut; and the occurrence of rigor and a high temperature, marked by a daily rise and fall of two degrees, would go far to make the diagnosis certain. But such a deep-seated swelling is not

always easy to make out, since the distension of the cæcum and the tenderness render an examination difficult. The recognition of the existence of an abscess will of course depend very much upon the direction which it takes. In the more chronic cases, and in those which originate independently of typhlitis, the symptoms are liable to be obscure for a long time. Long before there are the physical signs of a tumour in the iliac fossa, and when the occurrence of an injury may have been forgotten or not thought of, the patient will complain of pain and numbness or anomalous sensations extending down the right leg as far as the knee, with perhaps slight lameness, and a constant inclination to relieve the pressure of the abdominal walls by leaning over to the right side when standing and sitting, or by flexing the thigh on the trunk when lying down. The temperature is by no means always elevated, and the bowels may present but very little irregularity in their action. Nevertheless, the patient feels generally ailing, in an ill-defined sort of way, and, with a probably diminished appetite, loses flesh. Pain and tenderness on pressure may be absent in the iliac fossa. As the disease slowly advances, however, and the patient emaciates, more definite symptoms will present themselves; an increasingly distinct swelling is appreciable, of a notably fixed character, not shifting under manipulation, tender, and accompanied by an almost constant pain extending down the leg, which may perhaps be slightly œdematous, from pressure on the veins. The abdomen is usually slightly tympanitic; and the local swelling may increase to the extent of being visible. The bowels by this time are markedly irregular. Sometimes there is diarrhœa, sometimes constipation, or alternations of these conditions. The impairment of the intestinal peristalsis, caused by the pressure of the inflammatory new growth in connection with the cæcum, may by irritation produce diarrhœa, or by obstruction lead to constipation. The stools are frequently pale and unformed. Vomiting is sometimes met with in different degrees of severity.

Associated with the formation of abscess, a case has been described by Dr. Quain, in which there existed a certain subjective sensation of smell; a fæcal odour, which could not be recognised by others, being continuously complained of by the patient, to the extent of its being almost regarded as a monomania. This smell gave the patient no further annoyance after the abscess had discharged and subsequently healed.

Course and Terminations.—When an abscess has formed, the result will much depend on where it opens, and to what extent it communicates with the cæcum. Rupture into the peritoneal cavity will almost surely be fatal, and even those abscesses which burst on the surface may lead to death, by the exhaustion caused by a chronic cavity prevented from healing by its discharging fæcal matter. In the most acute cases, where no perforation into the bowel has taken place, the resulting abscess may burst on the surface; and the same may be said for many of the more chronic cases, when the progress of the inflammation has become arrested before it has implicated the bowel to any great extent, and when a partial absorption of the inflammatory tissue has taken place. But in other cases, and especially where there are burrowing sinuous channels in the iliac fossa, with more or less communication with the cæcum, recovery is of rare occurrence, and the patient dies from exhaustion, with perhaps caries of the bone, a fæcal abscess, and a chronic diarrhœa.

Diagnosis.—The diagnosis of these cases, previous to the recognition of a swelling in the iliac fossa, is only provisional. The history of typhlitis, with subsequent tenderness and, perhaps, high temperature, and especially an ill-defined feeling of illness, the patient steadily deteriorating in health, should lead to a suspicion of the extension of the inflammation beyond the cæcum. Should an abscess form and point, it will not be difficult to recognise, and when a swelling is to be felt, its nature will be ascertained by attention to the history of the case, the pressure-symptoms in the right leg, and the fixity of the tumour. The variable state of the bowels renders them of little account in forming a diagnosis. There is reason to believe that this malady is often passed over unrecognised, and is of more frequent occurrence than is supposed. This is said to be the case in children, in whom cases of iliac abscess around the cæcum are liable to be mistaken for hip-joint disease, though with perhaps scarcely sufficient reason.

Prognosis.—In the acute cases where a fæcal abscess forms and bursts, a fatal result, sooner or later, is to be feared. If rupture takes place into the peritoneal cavity, death will follow, and even where perforation of the abdominal wall occurs, the ensuing exhaustion is often fatal. Those cases of abscess in which the communication with the bowel has not existed, or has been cut off, are the most favourable. Among the chronic cases where the suppuration is but slight, the prognosis seems very much to depend upon the extent to which the intestine is implicated; if this be tolerably free a favourable result may be expected.

Treatment.—A large proportion of the cases of perityphlitis are amenable to treatment. Perfect rest in bed is of primary importance; and, since the symptoms are directly relieved by the reclining position, the imprisonment is readily submitted to. Hot poultices of linseed meal, or fomentations over the cæcum, and changed as often as necessary, almost invariably give marked relief; when an abscess is in process of formation, the hot applications favour its development, and so promote the cure, by affording an opportunity for its being opened. This plan, pursued for a week or ten days, may be sufficient. In the more chronic cases it may be necessary to continue them for a longer period, even when the tension appears to be lessened, and the pain in the limb decreased. When the more acute inflammatory symptoms have subsided, counter-irritation, by blisters or by a solution of iodine applied over the affected part, tends to promote absorption, and thus to remove thickened or condensed tissues.

Attention should be especially directed towards maintaining the general health. The diet should be small in amount, frequently administered, and of the most nutritive quality. Advantage is to be derived from the simultaneous

administration of the prepared digestive juices of the stomach and pancreas, so that a minimum of indigestible food may reach the lower bowel.

Stimulants, carefully administered, are often necessary. Care is required in giving aperients when the bowels are confined. As a rule this condition is best relieved by enemata and gentle laxatives, such as confection of senna or castor oil. Constipation is more favourable to the patient than diarrhœa, which is often uncontrollable, or obstinately resists the usual treatment of acids and opium, tannin and other astringents, whether given by the mouth or as enemata. It is much easier to relieve the bowels than to arrest their excessive action.

Tonics, such as iron, ammonia, and bark, are of value, and should be given from the outset, since the disease is one that tends to wasting, and it is usually in a somewhat enfeebled condition that the patient first presents himself. When the acute phase has passed, change of air, a sea-voyage, and other aids to convalescence are required. W. H. Allchin.

**PERI-UTERINE HÆMATOCELE.** *See* Pelvic Hæmatocele

**PERSONAL HEALTH.** — Personal hygiene is the science of individual health. As there are public acts and laws which, observed, promote the health of communities, so there are rules of living and habits of life, inculcated by competent observers, by attention to which the health of the individual may be preserved or increased. Health is a quality of body easily comprehensible, but difficult to define. It is dealt out in different measures at different periods of life, and is perhaps best described as exemption from disease. It admits, however, of being estimated, and we shall first show how this may be done.

First, the form of the individual must be examined to ascertain how far it agrees with or departs from certain mean standards, such as are laid down by anatomists and practical hygienists, and which give, in tables for each age, what the height, weight, girth of chest, and mobility of thorax ought to be every year of life. Thus above the weight of 161 lbs. avoirdupois, the circumference of the chest ought to increase 1 inch for every 10 lbs. of additional weight; and for every inch in height over 5 feet 8 inches the mobility of the thorax ought to increase in a definite ratio (*see* Parkes's *Hygiene*, p. 480). Then the girth-measurement, taken round the mamma, should be in excess of that taken lower down, at the level of the xiphoid cartilage, in every man, although not disproportionately so, as it is in women who lace tightly.

Secondly, the manner in which the various functions of the body are performed must be ascertained. The situation of the heart's apex-beat is to be determined; its impulse; its mode of action; the rhythm of its sounds; the way in which the circulation is being carried out; how temperature is maintained at the extremities; and what individual capacity exists to resist conditions calculated to lower the body temperature. The respiratory, cerebral, and spinal functions must all be determined; the organs of digestion sanguification, and excretion, as well as their performances, will have to be examined in due order; and the state of general nutrition and the condition of the skin appraised.

That state of body which enables it to perform every function which can be reasonably required of it, to accomplish each ordinary task, and be equal to some exertion of brain and muscle without painful sense of fatigue, is what we ordinarily understand as health. It would be difficult, however, if not impossible, to lay down the amount of work or exertion, short of positive fatigue, which a child, lad, woman, or man ought to be equal to without preparation or training of any kind. Erectness, firmness, good balance of body and mind, testify to a man, as they do to a racehorse or a gamecock. An experienced eye recognises at a glance the particular build of man suitable to particular taskwork; likely to excel in particular exercises, sports, or games; fitted to labour with his head, or with his hands; to run, swim, or fight well. There is, perhaps, a little less difference between man and man than between carthorses and racehorses, but it is one of degree only. *Fortes creantur fortibus*, and for perfect bodily aptitude for any trade, profession, or particular craft, the individual must be born, bred, and trained accordingly. We arrive at the following signs or evidences of health:—

*a.* Good construction; *b.* Accommodativeness to change, individual adaptability to widely diverse conditions of life, or of climate, without deterioration of energy; *c.* Endurance; *d.* Self-control—mental, emotional, sexual; and *e.* Resistance to morbific influences.

From birth onwards to old age health is not uniform; it varies as the body varies, according to wear and tear, and treatment—a sufficiently obvious proposition. At different epochs of life the strain, or stress, is felt in different parts, falls upon different organs, and issues in proclivity to disorder of their several functions, or in wear or degeneration of the tissues of which they are built. Our object here is to demonstrate how individual health may be secured; how disease-tendencies may be avoided or diminished; and how a reasonable measure of health may be attained throughout life, and at every period of it. To fulfil this endeavour we divide the life of a human being into the following periods, and consider them separately in relation to their special physiology, to morbid imminencies, and to probable accidents, laying down the best rules of guidance in diet, clothing, habits, exercise of body and mind; indicating whatever appears most conducive to the health of the individual at the age mentioned. It is of course of first importance to be born of a healthy, long-lived stock; but for heredity and its effects the reader is referred to the article Disease, Causes of.

**Life periods.**—The following are the periods of life, as they will be successively considered:—

1. **Intra-uterine life and Gestation.**
2. **Birth.**
3. **Infancy**, the period between birth and the completion of the first dentition.
4. **Childhood**, the period between 2 and 7 years.

5. **Adolescence**, the period between 7 and 14 years.

6. **Puberty**, the period between 14 and 20 years.

7. **Adult age**, the period between 20 and 30 years.

8. **Maturity**, the period between 30 and 45 years.

9. **Turning-time**, the period between 45 and 60 years.

10. **Advanced life**, the period between 60 and 82 years.

11. **Old age**, the period between 82 and 100 years.

1. **The Intra-uterine and Gestation Period.** The health, habits, and conduct of the mother during pregnancy modify the future individual considerably. Whatever affects the blood of the mother affects that of her fœtus, and *vice versâ*. There are grounds for thinking that the mother possesses and exercises purifying and excretory powers over the blood of her fœtus, appropriating into her own eliminating organs, and in some degree removing from her offspring, taints or disease-germs derived from the father of the child, perhaps suffering from these herself vicariously. This surmise has been offered to explain a fact not infrequently observed, that previously healthy wives, born too of healthy stocks, married to consumptive husbands, after breeding one or more children, tend to die themselves of a rapid form of phthisis, although bearing children not necessarily consumptive. On the other hand, delicate women who have been impregnated by exceptionally sound sires are observed to improve in vigour and robustness with each succeeding pregnancy. It is certain that smallpox, scarlatina, and measles may be conveyed by the mother to the child *in utero*; that typhoid fever occurring to the mother is usually fatal to her fœtus; and that the poison of syphilis derived from either parent is extremely pernicious to the growth and development of the fruit.

Alcoholic abuses committed by the mother during pregnancy favour premature delivery, and appear beyond this distinctly prejudicial to the health of the children when these are born alive, the constitutional flaw not showing itself by apparent malnutrition so much as by undue proclivity in them to manifest disorders of the nervous system—chorea and epilepsy in childhood, hysteria and insanity in adult years. Experience shows the hygiene of this period to consist in temperate living. The pregnant woman should avoid excitements of all kinds, take moderate exercise, rise and go to bed early, not alter her habits of life abruptly. In the later months she must dress herself appropriately to her state, not so as to interfere with the emerging of the uterus from the pelvis, or so as to limit the movements of the babe *in utero*.

2. **Birth.**—Beclard in his work (*Hygiène de la Première Enfance*, Paris, 1852) pointed out a fact of some importance in the hygiene of birth. When the fœtus with its membranes and placenta are separated from the mother, and independent existence is commenced, a good deal of blood, properly the newborn child's, remains and is for a short time after actual birth lodged in the cord and placenta. If time enough be allowed, and the newborn be kept properly warm the while, all this blood—some two ounces or thereabouts, and therefore no unimportant quantity when the weight of the child is considered—will find its way into the infant's body; whereas, if the cord be tied and divided too quickly, and before the umbilical vein becomes collapsed and empties itself, the child is mulcted of its natural blood-endowment. According to Pinard's observations, it is easy to distinguish the babies who thus receive their full complement of blood at birth from those who do not. The skin of the former is rose-coloured and well plumped out, whereas the skin of the latter has an anæmic or icteric tint, and is poor; the former infants grow and develop more rapidly, and are altogether more vigorous than the latter. As a guide to the accoucheur's practice, he inculcates careful observation of the cord at birth. All pulsation ceases in the umbilical arteries directly the newborn breathes and cries; but for some while, different in different cases, the umbilical vein remains full; and the blood in it continues liquid up to the moment when its last drop is absorbed into the child's body. But the cord must not be ligatured until the umbilical vein is flat and empty. The accidents incidental to birth are multifarious, and belong to the subject of parturition. We may notice specially asphyxia from prolapse and compression of the cord; and prolonged pressure upon the infant's skull inducing epicranial cephalhæmatoma, and, rarely, apoplexy and paralysis.

If the temperature of the external air is about 60°, children may be allowed to go out when they are eight or fifteen days old, after cicatrisation of the umbilicus. Children born in February and September appear to possess the greatest vitality, those born in June the smallest. According to statistics carefully collected by Dr. E. Smith in his work on *Health and Disease*, p. 267, 'the viability of the infants born in the winter and spring months is greater than that of those who come into the world in summer or autumn.'

No artificial purgative oil, gruel, or sugar-water, should be allowed in lieu of the mother's first colostrum milk.

3. **Infancy.**—The period of infancy might be subdivided into *early* and *late*; *early* comprehending the time from birth to eruption of the first teeth; *late*, that from the commencement to the completion of the first dentition. The leading anatomical feature of this age is the large amount of blood relatively to the solids of the body, the laxity of all the tissues, the disproportionate quantity of component water, and the large relative amount of red blood-corpuscles and of iron, which appears far in excess of that existing in adults. See E. Smith's *Cycle of Ages*, p. 247.

The circumstance of chief physiological importance is that the greatest growth occurs in the first years of life Quetelet in his essay, *Sur l'Homme*, shows that the near average weight of male infants exceeds that of females; boys at birth weighing 3 kilogrammes 20 grammes, and girls 2 kilogrammes 9 grammes.

There is no indicator so infallible as the balance to prove whether an infant is or is not being properly nourished. It appears that from birth up to the end of the second day all newborns lose weight a little; they do not increase perceptibly till after the end of the first week.[1]

M. Odier states that it is usual to find an infant increase 30 or 40 grammes (461 to 606 grains) *per diem* during the first five months of life, 20 grammes (308 grains) a day from the fifth to the eighth month, and 10 grammes (or 155 grains) daily between the eighth and the twelfth month.

Dentition is the change most characteristic of the infant's growth and development.

In infantile life all the vital functions go on rapidly. The pulse at birth ranges from 130 to 140 per minute; and to the end of the first year is from 115 to 120. The rate of respiration is from 25 to 30. While the circulation is rapid, the skin, from its softness and vascularity, disperses heat rapidly; the cooling agencies are at a maximum; and the heat-maintaining powers, (that is, resistance to depressing influences) are at a minimum. 'The food taken by infants is, in proportion to the weight of the body, from three to six times greater than that taken by adults.' (Dr. Smith, *op. cit.*, p. 247.)

The perils from without to infant life are mainly derived from cold, those from within result chiefly from improper or defective feeding and hyper-nervous impressionability. It is not easy to over-feed young infants. If proper food, that is, their own mother's milk, be given them, they get rid of excess quickly enough by vomiting it, and the part not appropriated in growth or maintenance is stored up for future use as fat. The morbid tendencies of this age are towards the intestinal and mucous tracts. Catarrhal diarrhœa and bronchitis, thrush and stomatitis, are epiphenomena of all febriculas and states of malnutrition. Delirium and convulsions attend all general disorders. Over-rapid dentition is associated often with tubercularisation, retarded dentition with rickets. The more rapid the eruption of the teeth, the greater the attendant disturbance; the more closely the evolution of the teeth follows its normal periods (*see* TEETHING), the less conscious are infant and mother of their appearance. The hygienic rules for this period have reference principally to feeding, cleanliness, clothing, and open-air exercise.

DIET.—For diet the reader is referred to p. 362, where the proper aliment for infants is fully discussed. Experience proves that nature will not be contradicted—that no aliment is so appropriate as the milk of a mother, or of a wet nurse aged between twenty-two and thirty-five. Next best to this comes suckling by a goat; and next, again, a mixture of equal parts cow's and ass's milk given by a feeding-bottle. The suckling of her own infant by the mother for nine months is good not only for the child but for its mother. The uterus passes through its retrograde involution more properly, no periodic uterine congestions delay it, and ovulation is deferred. With respect to the frequency of feeding, and the quantity taken, the reader may be referred to the statements of Proust.[1] During the first day of life, what with scantiness of the colostrum, mechanical obstacles to suction, and the weakness of the infant's efforts, the child does not extract more than a drachm each time it is placed to the breast. It needs no more, however. During the first week of life it should be nursed ten times in the twenty-four hours, arranging times so that the mother gets six hours' consecutive rest at night. On the second day each suckling should furnish about 5 drachms of milk. On the third day each suckling should furnish about $1\frac{1}{2}$ ounces of milk. On the fourth day each suckling should furnish about 2 ounces of milk. During the first month average-sized infants require and obtain nearly 3 ounces of breast-milk at each nursing, and should be nursed nine times in the twenty-four hours, or receive about 27 ounces of milk a day. During the second month each suckling should furnish $4\frac{1}{2}$ ounces of milk, and the number of feedings may be reduced to seven *per diem*, which allows $31\frac{1}{2}$ ounces each twenty-four hours. At three months old the infant sucks about 5 ounces at a meal, an equivalent of 35 ounces each twenty-four hours; and at four months it extracts as much as $6\frac{1}{4}$ ounces of milk at each meal, which may be again curtailed to six each day, giving $37\frac{1}{2}$ ounces of aliment. This continues to be the quantity of milk and frequency of feeding required of a good nurse up to the end of the ninth month, but the quality of the milk during this period steadily improves, becoming enriched according as the child sucks more vigorously and at longer intervals, a provision fraught with mutual advantage to child and mother.

At the ninth month the child may be gradually weaned, although the age for weaning should be governed by the health of the mother or nurse, the forwardness of dentition, and the infant's own craving for other food. The best time to seize for the purpose is the interval or pause after the four lateral incisors are cut, and before the first molars appear.

*Dentition, normal order of.*—The two inferior incisors should pierce the gums between the fourth and seventh months; their eruption is attended by a slight six days' disturbance of health. Between the eighth and tenth months the two superior incisors and two superior lateral incisors appear within three or four weeks of each other, their eruption also being attended by slight fever and restlessness. A pause now ensues of from six to twelve weeks' duration, after which, and at some period between the twelfth and fifteenth months, six more teeth burst through within a few weeks. First, as a rule, come the two first molars of the upper jaw, then the two lower lateral incisors, and lastly the two lower first molars. Again a pause follows, lasting from eight to twelve weeks; and now, between the eighteenth and twenty-fourth months, the two lower canines appear, the upper ones succeeding them. Very little disturbance marks their eruption. An interval of six months now intervenes, and between the thirtieth and thirty-sixth months, or nearly on the completion of its third year,

[1] The infant should be weighed naked in a warm room lying on a piece of flannel of ascertained weight, in the scale of a balance sensitive to a drachm.

[1] *Traité d'Hygiène*: Paris, 1877, p. 115.

the child acquires its four last or permanent molars, the lower preceding the upper, and their cutting being attended often by general disorder, croupy symptoms, diarrhœa, and convulsions.

Cleanliness and Care.—The infant requires washing all over from top of head to sole of foot night and morning every day, and is best, because most quickly, immersed in a tub once daily. Infants who have had convulsions at any period of their lives are, as a rule, better washed all over with a sponge in the lap of their nurse than immersed in a bath, as immersion is apt to frighten them. The water should be the softest procurable. Rain water is best. The temperature of the room during the bath should be between 65° and 70° Fahr.; that of the bath itself, fixed by the thermometer, between 70° and 90°. Fixing the temperature of the bath should not be left to the possible indiscretion of a nurse; many a woman's hand will support water at a heat enough to parboil a baby.

The nurse should be required not to dawdle over bath or dressing; the former should occupy five minutes, the latter not more than twenty. Little or no soap, or only soft soap, should be employed. The drying should be accomplished with soft dry cloths, and for baby powder, to prevent excoriations, fuller's earth cannot be surpassed. Eczema and intertrigo are obviated by due attention to the frequent change of diapers and sufficient cleanliness.

Clothing.—No infant ought to be swathed like a mummy; it requires keeping warm, but should not be overweighted with clothes. Its chest must be free to expand, its limbs at liberty to move. The more lightly its head is covered, and the more quickly all caps are dispensed with, the stronger will be its hair and the less its susceptibility to catarrh. Night-caps are dirt-traps, and in all classes alike promote scalp eruptions by provoking perspiration, with which the skin is softened, and by whose decomposition the sebaceous follicles are irritated and clogged.

General Rules and Hygienic Advice.—Even the youngest infants require sunlight and open air. Due discretion must be employed, however, in sending them out. They are better carried in their nurse's arms, and thus assisted to maintain their own heat by that derived from their nurse's body, than placed in perambulators. So soon as they can crawl they should be encouraged to do so, either on a carpet, in a garden, or on a dry, sandy pathway protected from wind and open to sunlight. Cold and dark places are specially inimical to them; and when the weather is cold they should be encouraged to amuse themselves on a blanket or soft hearth-rug, so as to learn to stretch their limbs and co-ordinate all their muscular movements. They learn first to sit up, then to stand, helped by their arms, against a chair, next to stand without support, and at some period between one year and two years of age should be able to walk about by themselves.

Sleep.—Infants require day as well as night sleep. Very young babies do little else but suck and sleep. As they grow they need and take less and less sleep, and by the time first dentition is accomplished—three years of age—a child may usually dispense with day sleep altogether, except a short hour's nap early in the afternoon or between eleven and twelve. Sound sleep coincides in the infant, as in the adult, with short sleep hours, and the strongest children require least sleep. The infant should have its own cradle, and the child its own cot, placed close beside the bed with its mother or nurse. In extra cold weather, hard frosts, the cot should be artificially warmed by a hot water-bottle. The sleeping nursery ought not to be kept warmer than 65°, or colder than 50°, whilst the nearer it is maintained to 55° during the winter months, and 65° during summer, the sounder the child will sleep. The more freely the whole house and nurseries are ventilated, the less prone the infant will be to all infantile disorders.

4. **Childhood.**—In this period, between the second or third and seventh years of life, the first dentition is accomplished, the second uncommenced. The rate of pulse falls from 115 to 90 per minute, and respiration commensurately. The excretions are all absolutely increased. In the co-ordination of muscular movements and in mental operations great progress is being made. The cerebro-spinal structures, which nearly double in volume between birth and the second year, continue to develop disproportionately to the growth of the trunk and limbs between two and seven. The cellular tissues are loose and vascular still, and the cutaneous and mucous surfaces therefore extra vulnerable. A notable physiological feature of this age is the readiness to swell observable in the lymphatic glands upon the slightest irritation, and the general functional activity of all the lymphatic structures. It might be distinguished as the life period of greatest *lymphatic activity*. From these facts the morbid imminences may be inferred, namely, a tendency to eczema and to catarrh of mucous surfaces, diarrhœa, laryngeal and bronchial catarrh, general anasarca, hydrocephalus, susceptibility to contagious impressions, proclivity to tubercular meningitis, and to functional cerebral disorders like delirium and convulsions. The incontinence of urine, so frequent in early childhood, may be likewise referred to the reflex irritability of the spinal centres characteristic of this age. According to Lébert the cerebellum attains its largest size, relatively to the cerebrum, between four and five, to which circumstance has been referred the occasional sexual excitability and vicious practices discovered in some children at this early age. However this may be, the importance of good nurses and wise supervision cannot be too much insisted on, as also the inculcation of healthy habits and provision of proper amusements and employments.

Diet.—While bread, starch, and flesh foods are taking the place of cows' milk very greatly, they must not be allowed to wholly supplant it. Eight ounces of bread may be reckoned about equivalent in nitrogen content to one pint of milk, but the former exceeds the latter in carbon. The food must be nutritious and abundant. The error committed is far too often that of under than of over-feeding. Young children do not require so much variety in their food as adults do, but are greatly benefited by a change

in their bread and meal stuffs, and a dietary not too monotonous. They do not need meat more than once a day, and fish may be substituted for meat, if cream or butter sauce be provided with it, once or twice a week. Milk, bread, porridge, suet puddings and milky puddings should form the staple of their dietaries; fresh vegetables well cooked, watercress, cooked fruit, and oranges are most useful adjuncts; while the addition of fried bacon, clotted cream, and oil, or butter, when the drinking water is hard, and the tendency of the child is rather towards constipation than otherwise, is now fairly generally understood. It is usually easy and always beneficial to instruct young children to secure an alvine evacuation directly they rise of a morning and before their bath. Four meals a day are most appropriate—a breakfast at eight, a dinner at twelve, a tea at four, and a supper at eight.

Cleanliness.—Washing all over once a day, and in the morning, is as necessary as ever; but after first tubbing in warm water between 98° and 100°, the child should stand up and be sponged all over from a basin of cold water, and be briskly dried with a large towel.

Sleep.—A child should sleep in a cot or bed by itself, but in the same room with its parent or nurse, since they are apt to show any disorder by night vagaries, delirious talking, restlessness, or sleep-walking.

Between two and five most children are the better for twelve hours of sleep out of the twenty-four. At seven years of age they do not require day sleep, but should be in bed at eight, and up at six in summer and between six and seven in winter. The best bed for this age is an ordinary iron bedstead, with firm and level wool and hair mattresses; not spring beds, which do not adapt themselves so well to light bodies, or keep them uniformly warm. Cotton sheets, blankets, and counterpane must be used according to season. Beyond saying that the day clothing should be warm, and merino or wool put next the skin, we can add nothing further about clothing.

Exercise. — Two things are requisite for healthy growth and development and a happy childhood—a play-room and a garden. Children need a place like an empty barn, in which they can swing and amuse themselves in wet and wintry, as well as in hot sultry weather, practising those games which are requisite alike for the schooling of their muscles and nerves.

Teaching.—Teaching such as they need should be conducted on the Kindergarten system; but the main rule for their lives is open air and exercise, the chief objects being to harden their skins, develop their muscles, and teach them self-control, love and respect for those to whom they render implicit, because well-nigh unconscious, obedience.

5. **Adolescence.**—The consideration of this, the period of second dentition, between the ages of 7 and 14, is best prefaced by the order of eruption of the second teeth.

About 7 years the 4 anterior molars (permanent teeth) are cut.

About 8 years the 4 central incisors.
„ 9 „ 4 lateral incisors.
„ 10 „ 4 anterior bicuspids.
About 11 years the 4 posterior bicuspids.
„ 12 to 12½ 4 canines.
„ 12½ to 14 4 posterior molars.

The teeth of the lower jaw usually precede those of the upper. Second dentition is accomplished leisurely, and accompanied therefore usually by no such grave disorders as mark first dentition; but in nervous children nervous tricks may manifest themselves, as well as marked lack of emotional control. Some are hypersensitive, others contradictory and difficult; and most parents admit that between 7 and 8, if not between 7 and 14, they learn what the characters of their children really are. Physiologically, absorption of the subcutaneous fat goes on rapidly, while the muscles become more pronounced, the skin gets tougher, its epidermis harder, and it perspires less readily. In our climate the morbid tendencies of this age are to rheumatism, chorea, epilepsy, the exanthemata, and typhoid fever.

Between 7 and 8 the appetite is apt to become capricious; the child physiologically does not require so much hydrocarbonaceous food; and, while growing fast and becoming leaner, protests against fat, often while showing marked longing for fresh fruits, in which nature should be indulged. After 8, however, any marked defect of appetite or loss of weight is suggestive of undue cerebral excitement, attributable to overstudy or some infraction of the laws of health.

Diet.—Three good meals a day are sufficient, but four are more advisable. Constipation at this age signifies usually irregular feeding and overloading with pastrycook supplies, or improper food. Breakfast at eight, dinner at one, tea at five, and supper at eight appears the best distribution. By supper is meant such a meal as growing lads and girls positively need. They require either soup and potatoes, and bread and butter, or some one hot dish of meat or fish, and the drink should be either warm milk or cocoa to about half-a-pint of fluid; aliment enough is needed to improve the circulation at the extremities and obviate chilblains. Boys and girls may retire to bed within an hour of their supper, which, instead of making them dream, will secure good and refreshing sleep. The greatest dangers at this age arise certainly from defective nutrition and an over sensitiveness of the skin. Neither wine nor beer is necessary, nor should it be allowed without medical authorisation.

Clothing. — The objects of clothing are warmth, cleanliness, and convenience. Cotton or silk shirtings should lie next the skin of the chest and trunk. Merino, flannel, or woollen materials should protect the legs and feet; cloth, woollen jerseys, furs, and skins are better adapted for external coverings. But a whole chapter could be devoted to the foot alone, and its clothing during its growth and development. The desiderata appear to be length and breadth enough, low heels, impervious soles, old and flexible skins for uppers. Boots for out-door exercise are advised for children, because their ankles need support; shoes a little later on, because they are cheaper and do not repay re-soling, and may be discarded at once when worn out. The same boots should not be worn day after day, they

require time to dry properly in damp weather, and the foot at that age profits by change of pressure. During youth the adaptation of clothes to special sports and exercises is far from unimportant to health. For violent muscular exercise flannel or merino next the skin, and an easy flannel jacket or over-jersey should be worn; both after being used should be hung up to dry and air before being worn again. It is well that youth should be reminded that rheumatism is probably too often inflicted upon those who are careless about their dress, and negligent enough to wear the same clothes which have been saturated over and over again with the secretions from the skin.

Rest and Exercise.—These are requisite for both body and mind at this age; the duty belongs to parents and schoolmasters to study what is appropriate. We annex, therefore a table from Friedländer, which shows how the twenty-four hours may be wisely apportioned:—

| Age. | Hours for | | | |
|---|---|---|---|---|
| | Exercise. | Work. | Leisure. | Sleep. |
| 7 | 8 | 2 | 4 | 9 or 10 |
| 8 | 8 | 2 | 4 | 9 or 10 |
| 9 | 8 | 3 | 4 | 9 |
| 10 | 8 | 4 | 4 | 8 |
| 11 | 7 | 5 | 4 | 8 |
| 12 | 6 | 6 | 4 | 8 |
| 13 | 5 | 7 | 4 | 8 |
| 14 | 5 | 8 | 4 | 7 |
| 15 | 4 | 9 | 4 | 7 |

6. **Puberty.**—The physiological feature of this age is the more rapid growth of the whole body, and the gradual perfectioning in their functions of its several organs. The human plant attains the fulness of its organic life, and the energies are rather expended on corporeal formation than on intellection (if we may coin such an expression). Growth in man, as in plants, proceeds by fits and starts, succeeded by periods of quiescence; seasons affect it, so do supplies of food; boys do not develop so rapidly in autumn and winter as in spring and summer. Girls at this age often fall back, as it were, a little in winter, when they are much more confined indoors, to make a greater push forwards in spring.

It is even difficult for the digestive and assimilative powers to keep pace with the bodily requirements, so that the tendency is for the temperature of the body to fall somewhat, to be ill maintained at the extremities, and for the cold bath to be shunned for lack of adequate reaction in those who are manifestly growing very rapidly.

The heart in some is hardly equal to the task set it, and when diseased we perceive both growth and the attainment of puberty retarded. The lungs, again, as Dr. E. Smith pointed out (p. 288, *op. cit.*), more often in girls than in boys, do not expand in proportionate ratio with the rest of the body. The body runs up tall, but the thorax remains narrow and flat, and the apices of the lungs approach too closely to each other. The definition of a line—length without breadth—is too closely imitated. The morbid imminences of this age are few: disorders of the nervous system, chorea, and epilepsy may arise; anæmia and rheumatism are common enough. Girls suffer more than boys, probably in consequence of insufficient gymnastic exercises, overstudy in cramped postures, and from that folly of follies, a forcing-pit education, 'all articles warranted to be turned out highly finished by eighteen years.' It is the age of all others when good or bad habits of life are formed; the time, too, when the seeds of disease are sown broadcast, to spring up in the after age of man- and womanhood.

Diet.—Food should be abundant, varied, but unstimulating. Three or four moderate meals a day are requisite; if at any period of life fermented liquors are beneficial, now is that time. Light bitter unadulterated table beer or claret and water should be provided at dinner, but not more than half or three-quarters of a pint of it allowed. If violent exercise has provoked thirst, this may be satisfied with plain water or toast-and-water *ad libitum*. Girls should take cocoa-nibs for breakfast, with bread and butter, meat, eggs, bacon, or fish, as much as they like. School dietaries err usually on the side of deficiency. At dinner, as well as substantial meats, fruits, vegetables, suet and milky puddings are required. Tea should be allowed only once in the twenty-four hours, at six o'clock, and a warm supper be provided at nine o'clock.

Clothing.—Nothing need be added to what has been already advised. Without entering into minute particulars, it should be seasonable, rather extra warm, and offer no uncomfortable restraints. When mothers complain of their daughters' neglected figures, the hygienist retorts, What gymnastic exercises did you require of them? It is the age for exercise of the body as well as of the mind; boys' spines are straight and girls' backs crooked because the former use all their muscles and the latter do not; as the body is making its most rapid growth, so the evil of unilateral use of muscles is particularly baneful. Sitting over-long in a slouching attitude will tend to contract the chest, as carrying too heavy weights over the back will spoil the normal spinal curves; so leaning too much on one side, standing too long on one foot, even carrying constantly a pocketful of articles on one side of the dress, will suffice at this age to induce spinal curvature. The daily use of the trapeze, swinging, playing games like *la grâce*, in which both arms are used, badminton, and lawn-tennis, in which arms and legs are employed, and every muscle brought into due action, are quite essential to the proper development of the thorax and the muscles of the trunk. Girls should row and run and ride and swim and skate no less than lads do, in order to become fit mothers for a nation like ours.

The best temperature for a sitting-room is 60°; that for a sleeping-room between 50° and 55°. The hygiene of the bedroom and the bed needs a few words. The temperature of the room should not rise above 65° in summer, or fall below 45° in winter; it must be thoroughly ventilated with a constant amount of fresh air passing through it during the day. The deside-

rata for a bed are coolness for the spine, restfulness for the trunk muscles, and warmth without too great heat or too burdensome a weight of bedclothes: all objects are well attained by a French *somnier elastique*. A horse-hair bolster is preferable to a pillow, and a paper pillow to a feather pillow; a feather pillow enwrapping the neck and head heats the upper part of the spinal cord undesirably. Posture in bed is not unimportant. The head should be low, the feet perhaps a trifle raised, certainly not dependent. 'Sleep not on your back, as a dead man,' is a maxim attributed to Confucius; the opposite attitude, on the stomach, is restrictive of the intestinal movements, and uncomfortable. It is as well to begin the night lying upon the right side so long as food remains in the stomach, and to turn on first waking upon the left side. The best attitude is probably that crouched one habitually selected. Good advice is to stretch yourself straight whenever you wake, in order to render the circulation of the blood freer. In winter the arms should lie under the clothes, in summer above them.

The cold bath, or cold sponge, or shower-bath should be taken by the robust every morning; with an occasional warm or tepid bath once a week, for cleansing purposes, throughout summer and winter. Whilst the young of both sexes should be encouraged to swim, in seasonable weather, the length of time they stay in the water must be strictly limited according to the temperature.

We abstain purposely from any discussion of the hygiene of *mental* education.

**7. Adult Age.**—This is the prime of life, between 20 and 30. Anatomically, the body broadens, the chest deepens; for feats of muscular prowess—short, severe labours—it is at its best. The intellectual and cerebro-spinal sexual energies are at their maximum. What the French call the greatest latitude of health, that is, strength, exists at this period; severe strains are supported with apparent ease. In male adults the body gains weight by small amounts for about twenty-eight days, then relapses to its normal average by a sudden crisis, attended by head-heaviness, loss of appetite, and copious discharge of urine, or seminal evacuation. It is not a time about which the hygienist has much to say. If the preceding periods of life have been wisely ruled, the individual is at his or her best. The morbid imminencies directly belonging to this age should be few, and certainly are usually due to direct contravention of the laws of health: to exposure to contagious influences, to irregular living, especially drinking, to excessive strains upon the heart or its blood-vessels, to pulmonary inflammations, to contravention of proper sexual relations, to over-emotional excitement, or to mental worry and loss of sleep.

The guiding rule for this period is succinct enough: '*Sustine et abstine.*'

> *Qui studet optatam cursu contingere metam*
> *Multa tulit fecit que puer sudavit et alsit.*
> *Abstinuit Venere et Baccho.*

Hitherto excess in feeding was difficult to effect, quickly punished, and admitted of rapid and spontaneous repair; but now he who would rise above the ruck must rule with a tight rein all his appetites. The penalties are not exacted directly after the offence is committed; they are kept in store, but nature inflicts them with pitiless justice.

Total abstinence from alcoholic drinks may be recommended. Not only does it favour health, but lessens all the temptations incident to these important years, in which a man carves out his own career. A question not infrequently propounded is, How shall I know when I have eaten more than is good for me? If individuals are dull or drowsy after a meal they have usually eaten too much; if they can converse, write, or transact business with ease after a meal, they have fed temperately.

Women may be advised to marry not earlier than 21—between 21 and 28—when in our climate they are best fitted to become wives and mothers. Men had better wait till between 28 and 35 to undertake the responsibilities of being parents. For the generality of men and women we must insist once more on their not giving up out-of-door muscular exercises. An entirely sedentary trade or office-life cannot be a healthy one for either body or mind; the latter appears to suffer most from it—the sense of morality becoming blunted. When the struggle for existence is so severe that, with early rising and very limited hours of sleep, no leisure hour remains for sports or amusement, the time has arrived for emigration, war, enforced military service, or revolution.

Sleep.—Doubtless different constitutions and individuals differently employed require different amounts of sleep. While nothing dulls the intellect and weakens the recuperative faculties more than too much sleep, except over-feeding and drinking at this age, so few things are more certain than that a man may rise too early for making the best use of his twenty-four hours. He must live in the world and keep the world's pace still. John Wesley's advice in this matter is worth recording. He writes that any man can find out how much sleep he really requires to repair his nervous system by rising half an hour earlier every morning until he finds that he no longer lies awake at all on going to rest in bed, or wakes up until it is time for him to get up. Six to eight hours is usually ample for healthy adults, with nine hours every seventh day. The mistake too often made is that of endeavouring to make up for overhard mental efforts by overlong sleep hours. Mental over-fatigue is to be repaired not by sleep but by bodily exercise in the open air. Exercise directs the blood-flow from the head towards the muscles, and renews the appetite. As we have pointed this out as the suitable age for marriage, we may mention some things which conduce not slightly to healthful and happy marriages: parity of station, similarity of temper and tastes, and no disproportion either in age or size.

**8. Maturity.**—The body has now reached its maximum weight and solidarity, and the period is that of maximum endurance. Men reach their full weight at 40; women later, sometimes not till 50. At this age the soldier is fittest for service, the labourer for work, the artisan and professional man for their respective duties.

'High to soar and deep to dive is given to man at thirty-five.' The morbid tendency is towards anæmia and obesity, the former promoting the latter, and both alike being determined by a too sedentary town-life and by daily occupation in close, ill-ventilated, and badly-lighted chambers. Now are perceived the first attacks of gout; whilst visceral degenerations and atheroma of arteries may manifest themselves—events all of which may be delayed, if not wholly prevented, by attention to the laws of health. It is desirable that each individual should pay heed to his weight at this age, since this indicates whether or no he is living wisely. Celsus (*lib.* 2, *cap.* 1) writes:—'Corpus autem habilissimum quadratum est neque gracile neque obesum. Nam longa statura ut in juventa decora est sic maturâ senectute conficitur. Gracile corpus infirmum, obesum hebes est.' When, however, men are engaged in trades or professions there is no more difficult task than to maintain their weight at this age, the *juste milieu* referred to being a hard matter to secure. The advice given by Celsus (*lib.* 1, *cap.* 1) cannot be surpassed in force or brevity: 'Sanus homo qui et bene valet et suæ spontis est nullis obligare se legibus debet; hunc oportet varium habere vitæ genus, modo ruri esse, modo in urbe, sæpiusque in agro, navigare, venari quiescere interdum; siquidem ignavia corpus hebetat labor firmat.' As to diet, clothing, and habits, we need add nothing to what has been already advised for a previous age; but on exercise of body and mind there is much to be written.

A good rule is laid down by Lynch, too, in his *Guide to Health* (p. 290), that the lean should exercise *ad ruborem, i.e.* to glow-point, or until their bodies and spirits are heated, for that will fatten them; and the fat *ad sudorem.* The more luxuriously a man lives, the more exercise, and the more active exercise, he needs. Want of it, and the costive habit thus superinduced, may, as Kotzebec observes, extinguish the divine flame of genius and seriously impair the intellectual powers. Hypochondriasis and hysteria are the special punishments of ease and affluence and indolence. Obviously a portion of each day should be set apart for exercise. In the households of the wealthy a gymnasium is at least as important as a bath-room; and twenty minutes every morning before breakfast might well be devoted to breathing the muscles—that is, calling into play every muscle of the trunk and limbs. The chest should be expanded by clubs and dumb-bells; swinging on the trapeze, and hanging by the arms and legs, may be recommended. Again, before forenoon or mid-day meal, an hour's ride or walk must be obtained, and a third time in the day an hour and a half's exercise—fencing, or walking, or rowing—should be arranged before bed-time, in the spring and summer seasons. A great point is to vary the exercise by every means at hand; to change the set of muscles called chiefly into play upon different days, as Celsus advised; to swim, ride, fence, sail, row, shoot, fish. Lastly, we can recommend only those who are very robust to take a long walk before breakfast. Bodily exercise should not be undertaken immediately after a heavy meal; nor should those who have sweated themselves violently sit down at once to a full meal—at least an hour's rest should intervene.

Mental exertion is advantageous to health; even carried to excess, it lessens, rather than increases, waste of tissue. Over-work of a mental kind, with anxiety, appears attended by lessened appetite, lessened nutrition, and loss of body-weight—proof positive of detriment received.

9. **The Turning Period.**—This period of life, which lies between 45 and 60, is also known as *the grand climacteric*, or *middle age.* The skin wrinkles. Up to 60 years of age the skull may continue to increase in size, principally at its anterior part, by enlargement at the frontal sinus; after 60 the skull-cap loses weight, and the brain may waste but gets tougher and firmer. The heart grows a little larger, and its walls are thicker. The lungs grow denser, a change common to every tissue of the body. The hair grows gray; the features sharpen; the sight alters; and the hearing grows dull. Pressure and wear and tear begin to tell at every part. Upon the blood-vessels their effects are more marked in males than females, because ordinarily the former labour harder than the latter; further, the death-rate of men is greater than that of women at this age. As the sexual powers decline, which they do by a quick descent between 46 and 63, the intellectual powers increase, so that mentally there is often exhibited a marked increase of vivacity and agreeableness, more noticeable in men than in women. In the latter the cessation of the catamenia is attended usually by some rejuvenescence, attributable to their recovering a little embonpoint. It is an age, however, at which women kick rather, and become restless and uneasy, the change of life being attended in many by a renewal of their juvenile tempers, as between 7 and 14, and occasionally by a revival of their youthful ailments, as eczema, skin eruptions, and various neuroses, insomnia, hysteria, and sometimes epilepsy. In character, whatever obstinancy exists reaches its climax.

Morbid Imminences.—The inflammatory disposition is lessened, but there is a tendency to venous plethora of the abdominal viscera and towards vicarious hæmorrhages. Gout assails its victims with well-characterised attacks. New growths, simple and malignant, tend to demonstrate themselves, and rheumatoid arthritis to appear. Dr. Waterhouse, in a letter to Sir T. Sinclair, published in his *Code of Health and Longevity* (vol. i. p. 33, Edinburgh, 1807), notices the three following periods as very important in every human life, as sickly or moulting times. The first he had noticed to befall males chiefly at thirty-six years of age, when the lean person becomes fatter and the fat kine leaner. The second sickly period happens at some time between forty-three and fifty, and lasts a year, or perhaps two. During it the complexion fades, the appetite fails, the tongue becomes furred at the smallest over-exertion of body or mind, the muscles are flabby, the joints are weak, sleep is unrefreshing, and the spirits droop. It is no particular organ that suffers, but a uniform deterioration that is manifested. At this time a man first experiences a reluctance

to stoop, prefers a carriage to riding on horseback, and perceives each change of the weather affect him. This observation of Dr. Waterhouse has, according to the experience of many, much justice in it; as also that between sixty-one and sixty-two a similar deterioration of health takes place, but with aggravated symptoms.

Hygienic Rules.—At the menopause women should be advised to abstain, as a rule, from alcoholic drinks, and avoid highly spiced and seasoned dishes. They may be recommended to take meat not more than once daily, and to live chiefly on farinaceous food, milk, eggs, vegetables, and fresh fruits. A tablespoonful of lime-juice taken twice daily occasionally for a week or ten days at a time has a salutary, depurating effect upon both stomach and kidneys, and clears the tongue when this is foul in the morning. Riding and walking exercise are highly appropriate, but very violent muscular efforts should be avoided. If the individual be thin and growing thinner, the clothing should be extra warm. Flannel abdominal belts may be worn advantageously in all seasons, but especially in autumn and winter.

Both sexes should avoid emotional excitement and the stimulation of waning sexual abilities. Prolonged exposure to wet and cold is sure to be seriously resented. Hot or Turkish baths, succeeded as they should be by cold plunge or douches to remove the lassitude otherwise provoked, are very beneficial, and taken once a week may be safely indulged in throughout the year. It becomes extra important as the subcutaneous fat gets absorbed, and the skin wrinkles, to keep its pores clean and open and capable of perspiring.

10 and 11. **Advanced Life, and Old Age.** The period of advanced life—sixty to eighty-two, and old age, from eighty-two upwards, may be advantageously considered together. When a man turns his toes out much in walking and treads upon the whole base of his foot, and is always stopping to look back, he is already old. The sagacious 'boots' at an inn can tell a man's age by the state of his shoe-leather.

'*Senectus ipsa morbus insanabilis.*' Some degenerate earlier than others, but the decline of life is characterised in all human kind alike by an indurating condition of every tissue diametrically opposed to the cellular softness and laxity of infancy. The capillaries thicken, the arteries harden, the nutritive metamorphoses proceed more slowly. The muscles waste; the subcutaneous fat lessens; the blood becomes poorer and paler; the skin dry, sallow, and wrinkled; further, it gets less vascular, and the mucous surfaces become relatively more so. The teeth loosen and fall out; the gums recede from them; and the digestive juices fail. The arteries become atheromatous and calcareous, lose their elasticity, and are liable to fibrinous thromboses, or to embolic pluggings; and while they tend to block up at one part, their coats may split and yield to pressure, bulge out, and form aneurisms or dilatations in other directions. Hence happen apoplexies, brain-softenings, and senile gangrenes. The heart up to an uncertain period grows progressively larger and more muscular, to meet the obstacles offered to the circulation; but finally it, too, degenerates, and its walls grow thinner and dilate. The air-cells of the lungs lose their elasticity, and progressively enlarge; then merge into each other; and become emphysematous at the edges of the lobes where least supported. Emphysema implies degeneration of capillaries and diminution of aërating surfaces; and as the pulmonary area becomes thus lessened, the right heart becomes hypertrophied and dilated.

The dryness and lessened secretion of the skin cast harder work upon the kidneys in eliminating water, and increase the disposition to catarrhal fluxes from the nasal passages, the bronchi, and the intestines. Thus, while there is a constant predisposition to skin-irritation from its dryness, and to eczema from scratching and rubbing it, the other morbid imminencies towards bronchial catarrh and diarrhœa very closely follow the direction given them by the season of the year and greater or less degree of external cold. The bladder grows thicker with age, and its capacity is less; the prostate gland enlarges. Few persons after 60 pass seven hours in bed without requiring to micturate. Dr. Rush regarded the necessity for more frequent micturition the first symptom indicative of a man's years impairing his bodily functions. The pulse feels firmer and fuller; fills quickly after food is taken; but falls in frequency and flags in power in a marked degree after fasting. It is a far less trustworthy indicator of the gravity of any febrile disorder, or of degrees of asthenia, than it was in youth or middle age; and it fails to point to the practitioner the nearness of death, unless he have large experience of it.

There is a default of reaction manifest in advanced life, so that all acute disease is clinically less easy of recognition, and the beginning of the end is therefore apt to pass unobserved. The thermometer warns the doctor of changes which old people do not notice themselves, but which it may be of considerable importance to notice. A slight elevation of temperature means much in old age, and should be heeded accordingly. The slightest change excites a young child; nothing seems to move the old man. In extreme old age life is little more than vegetative existence; the individual eats and sleeps and dreams. The sleep the aged get by night does not satisfy them. Memory is one of the first mental faculties to become impaired, but finally every sense and faculty fail. Up to 75 the strong of both sexes retain their digestive powers, and a fair amount of mental and muscular vigour.

Hygienic Rules.—A prime necessity for old age is warmth; nothing kills the aged so certainly as cold. It is of first hygienic importance after 75 that the individual should be loved and cared for; old people do not, perhaps cannot, take care of themselves.

Those who live longest and enjoy the fullest measure of activity are those who do not overtax their stomachs when their teeth begin to fail them, and who adapt their aliment to their enfeebled powers of mastication by having their food properly cooked for them. Stews, minces, meats boiled and afterwards baked—cooked, that is, twice—are more easily digested than fresh

roasts or close-fibred meats. A moderate amount of wine both cheers and comforts old people; a glass or two of good Burgundy or of champagne, and an occasional glass of old port wine, is most beneficial to aged persons, and is better for them than overloading their stomachs with milk and farinaceous foods.

Great attention should be paid to the functions of the bowels and of the skin. Galen pointed out that old people should not suffer their bowels to remain costive beyond two days; on the third they should take some gentle purge, such as by experience they have found adequate to open their bodies. A hot bath once a week, and a hot foot-bath every night, may be advised. A short nap after breakfast and before dinner is the natural habit of the aged. Further, their clothing should be extra warm, and their chambers night and day be heated. They should be encouraged to go out in the open air only in seasonable weather, and when they are equal to it should take a little walk on a dry gravel path in some warm locality, sheltered from north-easterly winds. All change and cheerful society is good for them. If their purses admit of it, they should follow the swallows to warm winter quarters. If they must winter in England, let them shut themselves up throughout it in a well-warmed house.

Summary.—Advice for every age may be thus briefly given: for infancy and childhood—*sustine*; for adult years—*sustine et abstine*; for old age—*sustine* again. There is less need now to enjoin *abstine*.

The hygienist, however, seeks not to lengthen out the days of age and decrepitude; his art is not to prolong life beyond its natural term, though this may come subordinately, but to render its period of activity and utility longer—'*Hic labor hoc opus est.*' Some cynic observes that we have pointed out very few habits as worth cultivating, the truth being we believe what we have insisted on—that most bodily habits need resisting. Individual health is attained by self-denial; habits imply self-indulgence.

Reginald Southey.

**PERSPIRATION, Disorders of.**—Synon.: Fr. *Troubles de la Sueur*; Ger. *Störungen des Schweisses*.

This subject will be discussed in the following order:—1. Hyperidrosis; 2, Anidrosis; 3, Osmidrosis; 4, Chromidrosis; and 5, Hæmatidrosis.

1. **Hyperidrosis.**—Definition. — Excess of perspiration.

Ætiology.—The cause of hyperidrosis, though certainly connected with the vaso-motor nerves, is still obscure. Often hyperidrosis seems to be reflex, and excited by irritation of a more or less distant part, such as food in the mouth, by which the muscles of the blood-vessels relax, and admit more blood to the sweat-glands; there being, as far as is known, no direct connection of the sweat-glands with the nerves.

Description. — Hyperidrosis may be either *general* or *local*.

*General* hyperidrosis occurs in acute rheumatism, gout, intermittent fever, pyæmia, phthisis, general debility, alcoholism, and the defervescence of febricula; in hot weather; in emotional excitement; or after severe exercise. It also follows the use of the vapour or Turkish bath; and is produced by diaphoretics, such as spirit of nitrous æther, opium, antimonials, and especially jaborandi.

Paroxysmal sweating of rapid onset has been seen in one or two cases where the patients still had, or had had, epileptic fits.

*Partial* hyperidrosis usually occurs on one side of the body, or of the face and head. Numerous cases are recorded where unilateral facial sweating followed cerebral hæmorrhage, and accompanied hemiplegia; or occurred with suppurative parotitis and salivary fistula of the same side. In these the sweating occurs chiefly during mastication, the cheek being also reddened. Hyperidrosis lateralis sometimes occurs on the right or left side when the tongue is touched with salt on the corresponding side. Some cases of lateral hyperidrosis faciei occur without previous assignable cause, and in one the affection was transmitted for three generations. Partial sweating may be limited to the palms or soles, and is sometimes hereditary. The sweat is constant and profuse, and the parts are red, tender, and sodden.

Excessive sweating may cause sudamina and miliaria, and lead to an eczema of considerable severity.

Treatment.—In the treatment of excessive sweating general tonics, sulphuric acid, quinine, iron, or strychnia, may be employed. Flannel should be worn, instead of cotton, on the skin, and woollen socks instead of cotton. The skin may be sponged with very hot water; with vinegar and water (1 to 3); or with lotions, such as one thus prepared—℞ acidi sulphurici diluti ʒij, aquæ Oj.; or ℞ acidi tannici ʒj, spiritus vini rectificati ʒvj. Powdering with talc or violet powder will relieve temporarily some cases of profuse sweating in acute rheumatism. Hyperidrosis in phthisis has been temporarily benefited by zinc, hyoscyamus, or sulphate of atropia ($\frac{1}{70}$ to $\frac{1}{35}$ of a grain *pro die*) administered with care. Belladonna liniment is one of the best remedies in local hyperidrosis of hands and feet.

2. **Anidrosis.**—Anidrosis, or deficiency of sweat, is merely a symptom in general diseases with a large flow of urine or renal disorder—for example, diabetes insipidus and mellitus, and Bright's disease. It accompanies the earlier stages of fever; and is a constant symptom in skin which is the seat of ichthyosis, psoriasis, or prurigo vera. Some persons habitually sweat little, especially in winter, and the skin is dry and rough, partly from deficient sebaceous secretion (xeroderma).

3. **Osmidrosis.**—In some persons the sweat, if retained on the skin, has a bad smell, especially that secreted by the armpits, perinæum, genitals, and the feet and toes; and to this disorder the name osmidrosis is given. The smell appears to be due to chemical conversion of the mixed secretion of the sweat and sebaceous glands, under the influence of moisture, and in the presence of macerated epithelium, into the higher fatty acids (caproic, &c.). Removal of the accumulated secretions by thorough washing removes the smell for a time. The underclothes

also become saturated with the sweat, and smell badly. This affection is not uncommon in females in the armpits, and it may be a serious affliction from the annoyance it causes to others.

Treatment.—This consists in extreme cleanliness, repeated washing with tar-soap, thorough drying, and frequent change of linen. The parts should be powdered with oxide of zinc and rice-starch (1 to 4), and tincture of belladonna internally should always be tried. Hebra strongly recommends the following ointment (*Unguentum diachyli*) for fœtid sweating of the feet, ℞ Olei olivæ optimæ ℥xv, Lithargyri, ℥iij, ℥vj; Coque; ft. unguentum. The ointment to be applied on strips of linen every twelve hours. Thin and others have had good results from disinfecting the stocking soles with a saturated solution of boracic acid. Cork soles must be worn, and disinfected in like manner. Careful inquiry should be made into the state of the general health.

4. **Chromidrosis.**—This condition, in which there occurs a secretion of coloured matter (indigo) by the skin, is so rare as to be of no clinical importance, though of much physiological interest.

5. **Hæmatidrosis.**—This, the so-called 'bloody sweat,' is also a variety, if it ever really occur. The reported cases are probably due either to rupture of superficial capillaries in the cutis, or to a similar rupture into the duct of a sweat-gland, out of which the blood finally escapes. The mechanism of this rupture, which seems quite unconnected with the secretion of sweat, is very obscure, though the highest authorities are sure that such 'spontaneous' bleedings do occur. A number of cases which have been reported in hysterico-neurotic persons were undoubtedly due to self-inflicted punctures.

Edward J. Sparks.[1]

**PERTUSSIS** (*per*, signifying excess, and *tussis*, cough).—A synonym for whooping cough. *See* Whooping Cough.

**PESTIS** (Lat.).—A synonym for plague. *See* Plague.

**PETECHIÆ** (Ital. *Petecchies*, flea-bites).—Synon.: *Peticulæ*; Fr. *Pétéchies*; Ger. *Petechien*.

Description.—Petechiæ are small crimson and purple spots of the skin, resembling those that result from the bite of a flea. They are circular in figure; are developed around the apertures of the follicles; have an average size of one or two lines in diameter; and are consequent on the transudation of the colouring matters of the blood, through the capillary vessels of the follicles, into the immediately adjacent tissues. They are distinguished from spots resulting from simple hyperæmia by pressure with the finger. Under pressure the hyperæmic spots disappear, but the petechiæ remain permanent. They are differentiated from flea-bites by the presence in these of the puncture, which is always perceptible, and contrasts strongly with the lighter colour of the rest of the disk; although it is to be remembered that the centre of the petechial spot is always deepest in colour, and becomes lighter towards the circumference. Petechiæ vary in tint of colour according to age and the amount of effused blood, being at first brightly crimson, then purple, next almost black, and subsequently fading away through the ordinary colours of a bruise. Hence it is usual to find them scattered over the skin of various shades of colour, ranging through all the tints already mentioned.

Petechiæ are met with on the mucous membranes, as well as on the skin, in purpura, scorbutus, malignant fevers, and in several forms of congestion of the follicles of the skin, associated with constitutional diseases. Petechiæ do not call for special treatment. *See* Purpura.

The term *petechial* is applied to certain varieties of diseases, such as typhus, when petechiæ occur in their course, or the eruption becomes hæmorrhagic. *See* Extravasation; and Typhus.

Erasmus Wilson.

**PETIT MAL** (Fr.).—A term applied to attacks of epilepsy which are of short duration and slight intensity. *See* Epilepsy.

**PFAEFFERS, in Switzerland.**—Simple thermal waters. *See* Mineral Waters.

**PHAGEDÆNA** (φάγω, I eat away).—A form of ulceration, which rapidly destroys the surrounding parts. *See* Bubo; Gangrene; Ulcer; and Venereal Sore.

**PHANTOM TUMOUR.**—Synon.: Hysterical tympanites; Spurious pregnancy.

Definition.—A peculiar enlargement of the abdomen occurring in females belonging more or less distinctly to the hysterical class. It is supposed by the patient to be a tumour, or to be due to pregnancy, though, in reality, it is nothing of the kind, as its name expresses; and it can be made at once to disappear by placing her under the influence of chloroform.

Description.—The phantom tumour consists in a more or less general prominence of the abdomen forwards, varying in degree. The enlargement may attain a considerable size, but is always quite symmetrical. The projection is most marked in the middle of the abdomen, and usually a depression or constriction is observed below the chest and above the pubes. It is rounded, smooth, and quite regular, presenting a uniform soft feeling, quite distinct from that of gaseous distension, fluid accumulation, or a solid mass. The enlargement is peculiarly movable, as a whole, from side to side. There is no sense of true fluctuation. Percussion yields a resonant note, but not usually excessive, and it may be of a muffled character. On examination *per vaginam* nothing abnormal can be detected, such as would be associated with ovarian or uterine enlargements, or with pregnancy. If there should be any doubt whatever about the nature of the supposed tumour, it will be at once removed by placing the patient under the influence of chloroform or other anæsthetic, when it immediately disappears, the abdomen becoming quite flat; but it gradually returns, even before the patient returns to consciousness, on the removal of the anæsthetic. There is no pain or tenderness in connection with the enlargement nor are any symptoms due to pressure or other causes observed; while the patient usually presents distinct signs of the hysterical condition. There ought, therefore, to be no difficulty in the

[1] Revised by Dr. Alfred Sangster.

diagnosis of a phantom tumour. What is the cause of the enlargement is by no means clear, but most probably it is due to a kind of paralysis of the intestines, depending upon disordered nervous influence.

Treatment.—In a patient having a phantom tumour, the general treatment for hysteria is that principally called for. She should be constantly impressed with the fact that the enlargement is not really a tumour, and is of no consequence. The condition is by no means easy to get rid of, but for this object galvanism may be applied to the abdomen, or in obstinate cases, the patient may be put repeatedly under chloroform. The use of pressure, by means of an abdominal bandage or elastic apparatus, might be serviceable in some cases. The bowels should be kept freely opened.

Frederick T. Roberts.

**PHARYNX, Diseases of.**—The pharynx is often involved in acute general diseases which affect the throat, such as scarlatina and diphtheria; or it may be implicated along with other structures in diffused inflammation of the throat, ulceration, gangrene, or morbid growths; but the diseases of practical importance connected with the pharynx itself which need to be discussed here are three, namely, 1. **Acute inflammation**; 2. **Chronic inflammation**; and 3. **Follicular inflammation.**

**1. Acute Inflammation of the Pharynx.**—Synon.: Fr. *Pharyngite aiguë*; Ger. *Acute Schlundkopfentzündung.*

Definition.—An affection of the pharyngeal mucous membrane, characterised by a non-exudative catarrhal inflammation.

Ætiology.—Some persons, though otherwise robust enough, show a particular predisposition to pharyngeal catarrh; and previous attacks seem to increase the predisposition. The young are, on the whole, more liable to the complaint than those more advanced in age; while all that brings the strength of the individual below par, whether over-work, exposure, or disease, more particularly of a specific nature, acts as a predisposing cause. Two of the most common exciting causes are cold and damp. At other times it may take origin in an extension of the catarrh from other organs, in a blood-poison, or in a direct irritant.

Symptoms.—Most frequently, though not universally, the attack is ushered in by a certain amount of fever. The patient experiences some degree of chilliness, if not actual rigor; is restless; his temperature is exalted; the skin is dry; and languor and stiffness of the body are complained of. This may precede the pharyngeal symptoms by some hours, but soon these begin to arrest attention. The patient discovers in his throat a feeling of soreness or fulness, speedily amounting to pain. This is particularly noticed when an attempt is made to swallow. And yet this very condition of dryness of the throat provokes him to renew the effort to swallow, the unpleasantness of which he manifests to the bystanders by the wry faces thereby induced. This desire to swallow is greatly aggravated if the uvula happens to be involved in the catarrh, as from its swollen condition it suggests the presence of a foreign body, which the patient endeavours to rid himself of by repeated swallowing. Cough is a frequent accompaniment, especially if the inflammation have extended downwards.

The inflammation may not extend into the larynx, but more usually this part is involved, and then the voice is altered in tone, becoming husky or hoarse, and it acquires the well-known 'nasal twang.' On inspecting the throat, it will be observed that the mucous membrane is considerably altered in appearance and colour, being tumefied and redder than in health. At first it is dry, often glistening, and tense. But as the case progresses this condition is altered, a secretion of mucus, more or less abundant, being poured out, bathing the tonsils and posterior parts of the pharynx. This gives rise to repeated hawking and attempts to expectorate. Occasionally this catarrhal inflammation extends into the Eustachian tubes, exciting considerable deafness and pain in the ears. At the same time the oral mucous membrane is affected, as evidenced by the usual symptoms of foul tongue, bad taste in the mouth, accumulation of saliva, and offensive breath. This acute variety, under effective treatment, usually subsides within a week.

Treatment.—Dr. Ringer urges the use of tincture of aconite, in drop doses every quarter of an hour for the first two hours, and afterwards hourly, if the angina has been seen at the very commencement. He states that the inflammation rarely fails to succumb to this treatment in twenty-four to forty-eight hours. The patient should be confined to bed; a brisk purgative administered; and bland nourishment allowed, including abundance of milk, ice *ad libitum*, and stimulants if called for. Warm fomentations or poultices may be applied externally, or a wet compress. Steam may be inhaled, and a warm spray, medicated with morphia, thrown into the throat every two hours. When the swelling and redness subside, and the parts no longer present the dry, tense appearance, but are covered with mucus or pus, then is the time to bring in the astringent gargles, or to paint the throat with glycerine of tannin or nitrate of silver. And now, also, tonics will prove useful.

**2. Chronic Inflammation of the Pharynx.** Synon.: 'Relaxed throat.'—This is by no means an uncommon affection, and may exist without having passed through the acute form.

Symptoms.—As in the acute variety, so here there is the same difficulty in swallowing, amounting even to pain when irritating substances are attempted to be passed into the gullet, but of course in an infinitely less degree. Persons suffering from this form of sore-throat are specially liable to exacerbations of the catarrh, giving to the affection more of a sub-acute character, and then their usual symptoms are all aggravated. The hawking and expectoration, which habitually go on, more or less, during the whole time of their toilet-making, is increased; and finding some difficulty in removing this tough mucus from the back of the throat, this hawking is continued till the mucous membrane itself is strained, and some of the ramifying vessels give way, and the patient is alarmed to see blood mixed with the expectoration. In some instances, especially in the case of those who are

habitual topers, this hawking in the morning is the prelude to the morning vomiting. The voice is apt to be husky, more particularly if the catarrh have at all invaded the larynx. On inspection of the throat, it will be observed that the mucous membrane is more or less reddened; it presents a roughened appearance; and is sometimes puffy-looking, with numerous veinlets running across it, and a quantity of mucus adhering to the posterior part of the throat: this last appearance is more common in the relaxed condition of the throat. This variety is not unfrequently found as an accompaniment of other diseases, as of phthisis, syphilis, disorders of the stomach, gout, and the effects of intemperance. The affection is usually very obstinate.

Treatment.—If the disorder be dependent upon any other affection, then of course the primary disease must be attacked. But in the case of simple chronic pharyngitis it will usually be found that the sufferer is considerably below par in his general health. This indication must be met, and the patient supplied with tonics; his habits of life altered, his business suspended, and much out-of-door exercise enjoined. Good nourishing diet should be ordered. Smoking must either be entirely prohibited, or if this be impossible, it must be much reduced. Locally, the affection is best treated by sprays or swabbing. Gargles seldom reach the parts; but if these are to be used, the best are those of alum, tannin, chlorate of potash, or bromide of ammonium. This latter is especially valuable in relaxed throats, with elongated uvula, and irritable cough. As sprays, many different remedies are employed, the most valuable being solutions of the following in distilled water, in the proportions indicated to the ounce:—Nitrate of silver, 5 to 10 grains; tannin, 5 to 15 grains; alum, 10 to 30 grains; sulphate of zinc, 5 to 10 grains; common salt, 10 to 30 grains; or glycerine diluted with water. In swabbing the throat, glycerine of tannin may be used, Lugol's solution, or the simple tincture of iodine. In some cases mineral waters are prescribed with success.

3. **Follicular Inflammation of the Pharynx.**—Synon.: Granular pharyngitis; 'clergyman's sore-throat;' Fr. *Angine glanduleuse*; Ger. *Chronischer Pharyngitis.*

This is another, by no means rare, form of chronic pharyngitis. On inspecting the throat of a sufferer from this affection, the posterior wall of the pharynx will be seen to present a mammillated appearance. The mucous follicles are much more prominent than is usual in health, and seem as if distended with their proper secretion. The submucous tissue, in which they are imbedded, is also thickened and hypertrophied. Occasionally these tubercles coalesce, and then a large confluent prominence is observed, studding, here and there, the posterior wall of the pharynx. In addition to the distension of these follicles, in some cases a large secretion of mucus is poured out, which, especially at night, hardens and concretes, and presents a dry, ugly, greenish-coloured crust on the back of the pharynx. At other times there is, on the contrary, a deficiency of mucus, and then there is observed a dry varnished-like appearance on the back of the throat.

Symptoms.—Each of these conditions gives rise to a considerable amount of coughing and hawking; more particularly is this the case when the adherent mucus is tough, tenacious, and difficult of expectoration. The voice becomes hoarse and husky, this being very observable after any continuous effort at speaking or reading. Swallowing is not attended with difficulty or pain. But the presence of these enlarged follicles in the throat suggests to the mind of the patient the necessity of swallowing, and consequently he makes frequent uncalled-for attempts to swallow. At the same time he perceives a sensation of dryness or pricking in the throat. Those who are the subjects of this disorder will generally be found to be over-worked men—often clergymen; and hence the erroneous name for the affection of 'clergyman's sore-throat'—or those whose bodily and nervous energy have been in any way reduced. It is a tedious disorder often lasting for years. There seems to be small disposition for the disease to extend to the larynx or lungs; but on examination by means of the rhinoscope, the same enlarged appearance of mucous follicles may, in some cases, be seen to extend to the utmost limits of the pharynx, and the mucous membrane is itself tumefied and thickened. If this condition be neglected, it may ultimately proceed a stage further, and the character of the secretion becomes altered, presenting a muco-purulent appearance, while the glands themselves become indurated and, in some cases, ulcerated. Occasionally it will be found that the mucous membrane and the follicles of the larynx take on this same form of chronic inflammation, specially when the disorder is persistently ignored for years. Arrived at this stage, the general symptoms become so aggravated as to forbid the patient, or his friends, any longer to neglect the disease. The hoarseness, always present in a certain degree when speaking or singing, becomes constant and intensified; and if the larynx be considerably affected there may be complete aphonia. And now more decided pain is complained of, and the individual no longer exhibits the same alacrity and interest in the pursuit of his avocations, but becomes indifferent to them, in consequence of the increased debility and general languor which pervades his whole system. Cough, however, is not a striking symptom; for if the disease do not invade the larynx to any great extent (and its tendency is rather to progress upwards than downwards), then the patient may be comparatively free from cough. The other structures in the neighbourhood of the pharynx become implicated, when the disease assumes the ulcerated form; and the uvula, tonsils, and soft palate become tumefied, swollen, elongated, and generally so enlarged as greatly to interfere with the inspection of the parts. The epiglottis also exhibits, in severe cases, a tendency to become crooked and ulcerated.

Treatment.—The general rules already laid down with regard to the treatment of chronic pharyngitis apply equally in this disorder, only, perhaps, with greater force. The constitutional treatment must be more decided. The patient must be absolutely forbidden to prosecute his employment or profession any longer, if he has any respect for

his health, be he clergyman, physician, barrister, singer, photographer, or inveterate smoker, for the habits and pursuits of these individuals are the very provocatives of the disease. The constitution must be braced in every possible way, by the use of generous diet, tonics, bathing, travelling. And to further the cure of the affection, attention must be paid to the secretions generally, these being stimulated or altered by the exhibition of small doses of blue pill, podophyllin, and aloes. Iodine in some form should be given. But the local treatment is equally, if not more, important, and to be effective must be regularly and conscientiously persevered in for months. There are various methods of effecting this, as inhalations of medicated fluids, insufflation of various powders, as alum or tannin; but the most certain and efficacious, because at once reaching the affected parts, and producing decided and visible effects, is the direct application of the selected remedy to the diseased parts by means of a large camel's-hair brush. And one of the best of these applications is a strong solution of nitrate of silver, varying in strength from twenty to eighty grains to the ounce of distilled water. If the parts be much ulcerated, a still stronger solution may be employed. Other medicaments which may at a later stage be used are the glycerine of tannin, or a solution of tannin in water (equal quantities of tannin and water), bromide of ammonium, tincture of iodine, or nitrate of uranium. Of course it must be left to the discretion of the practitioner to decide how often he should repeat these strong applications, as it all depends upon the nature of the case; but as a general rule it may be laid down that once every second day will be quite sufficient for the first fortnight, and after that two or three times a week will be often enough. This is to be kept up till the nodulated appearance is got rid of. As soothing applications the glycerine of borax will be found valuable, or glycerine alone, or olive or almond oil. Gargles are useless, as they never reach the affected parts. A course of mineral waters is sometimes of the greatest value. *See* MINERAL WATERS.

CLAUD MUIRHEAD.

**PHIMOSIS** (φιμόω, I confine).—SYNON.: Fr. and Ger. *Phimosis.*—A morbid condition of the penis, in which the glans cannot be sufficiently uncovered, on account either of congenital smallness of the orifice of the prepuce, or of disturbance of the natural relations between the latter and the glans by disease. *See* PENIS, Diseases of.

**PHLEBECTASIA** (φλὲψ, a vein, and ἔκτασις, extension).—SYNON.: *Hypertrophia venarum.*

DEFINITION.—An increase or spreading of veins, especially applicable to the minute venules of the cutaneous or mucous surfaces.

DESCRIPTION.—Phlebectasia is sometimes congenital, as when it gives rise to venous nævus; and at other times accidental, proceeding from relaxation of the tissues, or obstruction of the venous circulation. Phlebectasia, from want of tone of the tissues of the skin and weak contractile energy of the vessels, is most frequently met with on the cheeks and nose; whilst that which results from venous obstruction occurs generally upon the lower limbs. On the nose it is associated with small venous trunks which carry the returning blood into the deeper venous plexuses, and are very conspicuous.

TREATMENT.—The treatment of phlebectasia consists in improving the tone and vigour of the skin, removing palpable causes of obstruction, and applying local astringents. When torpid action is the chief cause, as happens in accidental phlebectasia of the face, daily friction with sulphur ointment is useful in exciting an improved nutritive vigour. Where large venules are present, as on the nose, they may be obliterated by a careful touch with potassa fusa, which forces the blood to seek a deeper channel. In phlebectasia of a nævous character a good treatment consists in painting the surface night and morning with liquor plumbi. But the capillary venous hypertrophy of varicose or obstructed veins is only to be benefited by the removal of the cause. ERASMUS WILSON.

**PHLEBITIS** (φλὲψ, a vein).—Inflammation of a vein. *See* PHLEGMASIA DOLENS; and VEINS, Diseases of.

**PHLEBOLITH** (φλὲψ, a vein, and λίθος, a stone).—A concretion formed in a vein. *See* VEINS, Diseases of.

**PHLEBOTOMY** (φλὲψ, a vein, and τέμνω, I cut).—A synonym for venesection. *See* BLOOD, Abstraction of.

**PHLEGM** (φλέγω, I burn; I distil).—A popular name for matter expectorated. *See* EXPECTORATION.

**PHLEGMASIA DOLENS** (*phlegmasia*, inflammation; and *dolens*, painful).—SYNON.: *Phlegmasia alba dolens;* Pop. White Leg.; Fr. *Phlegmasia alba dolens*; Ger. *Phlegmasia dolens.*

This is a disease having very distinct characters and easily identified. It has, therefore, been long familiarly known both to the profession and the public. Except in lying-in women, it is uncommon, few medical men seeing well-marked or characteristic cases of it under any other circumstances; and it is for the most part as a disease of the puerperal state that it has been the subject of study and investigation.

ÆTIOLOGY.—Phlegmasia dolens affects both sexes, and no age is exempt from it. It may attack any part of the body, but one or other of the lower limbs is the ordinary seat of it. Occasionally it seizes one lower limb first and then the other, or the disease may extend from the one to the other. The well-characterised disease, as it affects lying-in women, is an affection of the lower limbs. The left leg is far more frequently affected in the puerperal state than the right; and the left leg is supposed to be more frequently affected than the other under whatever circumstances the disease occurs. In lying-in women the comparative frequency of this affection, and of several other morbid conditions on the left side, is believed to depend on the circumstance that the parts on that side of the pelvis are more frequently subjected to pressure and bruising than the parts on the other side. This probably arises from the comparative frequency of the right lateral obliquity of

the uterus throwing the direction of the uterine power of labour across the mesial line to the left side of the pelvis. The disease affects multiparæ more than primiparæ. It is prone to occur in successive confinements.

From the variety of circumstances under which the disease may occur, it will be easily apprehended that it may arise in any period of pregnancy or of the puerperal state, but the time of appearance of the ordinary disease in lying-in women is the second week after delivery. It rarely commences in the first days; generally in the second or third week; seldom subsequently, in the puerperal state.

The special proneness of lying-in women to this disease probably depends on their hydræmic condition.

Besides the puerperal state, other conditions render the body liable to it. Among these are convalescence from fever — especially typhoid, dysentery, disease of the rectum, malignant disease of the uterus, interference with uterine fibroids, arrestment of menses, and malignant and tubercular disease generally. The disease has been frequently observed to affect the leg of the side corresponding with a previously commenced pleurisy. Occurring in connection with any of these conditions, the disease may vary greatly in severity, from being scarcely recognisable to its utmost degree of intensity. But its liability to severity is not the same in all circumstances. For example, in connection with malignant diseases of the womb it is often very slight and chronic.

Anatomical Characters.—The *post-mortem* appearances referable to phlegmasia dolens vary, especially in the presence or absence of thrombosis of the veins. Phlebitis, periphlebitis, and thrombosis are generally found; but besides these nothing special has been made out. The blood-clots vary in extent, sometimes occurring as high as the vena cava inferior. They vary in appearance, being more or less decolourised, more or less softened, or even diffluent. They may be adherent to the veins, even organised, or separable from them. They may block the veins, or may allow passage of blood through their substance. In recent cases the clot adheres to the internal coat of the vein, which is blood-stained. These coats are thickened and inflamed, and the surrounding cellular tissue is also sometimes specially hardened. In cases complicated with pyæmia there may be found suppuration in the clots, and other appearances observed in that condition.

Pathology.—Various theories, which reflect the pathology of the times at which they appeared, have been held concerning the nature of phlegmasia dolens. The disease was ascribed to a metastasis of lochia by many pathologists, and by others to a metastasis of milk. These views had no basis of facts, or very little; they rested almost entirely on authority, and disappeared as pathology improved. The discovery of the lymphatics in the last century led to the first attempts of a truly scientific kind to solve the mystery of the nature of this affection, the suggestion being that it arose from their injury and obstruction. But considering how imperfect is our acquaintance even now with the origin and distribution of these vessels, with the circulation through them, and with the effects of their injury or obstruction, we must still seek for information. The next attempt to account for this disease was based on the important discovery of the thrombosis of the veins of the affected limb. This was erroneously assumed to be an invariable or essential condition of the disease, which was accordingly now regarded as phlebitic. But the recurrence of the lesions regarded as essential, the phlebitis and thrombosis, without the development of the characteristic appearances of the affected limb; and, on the other hand, the occurrence of the characteristic appearances without the simultaneous presence of the phlebitis and thrombosis, demonstrated the insufficiency of the phlebitic theory. The next theory to be mentioned is a sort of retrogression to humoral pathology. It alleged, but merely alleged, that a morbid condition of the blood, of undefined nature, is, along with phlebitis and thrombosis, necessary for the production of the disease. This theory is nearly as deficient in basis as the lochia or milk theory. The confirmatory experiments on the lower animals, by injecting lactic acid into the circulation, are in the highest degree insufficient; and it leaves unexplained important points, such as the seat of the affection. The last theory to be mentioned is, perhaps, from its very novelty, likely to get more favour than it as yet deserves. It is that the disease, as it is seen in lying-in women, is essentially a parametritis—that is, an affection of the cellular tissue, commencing, indeed, in the close neighbourhood of the womb, but extending to remote parts; and, it may be, prevailing in them, while the original inflammatory affection of the womb and its immediate neighbourhood has diminished, or even disappeared. Parametric inflammation extends in a similar manner occasionally as far as the cellular tissue around the kidney. When it extends to a limb it is supposed to be the cause of phlegmasia dolens, and to have the phlebitis and thrombosis as concomitants or consequences of it. This theory is to a certain extent an old one in modern habiliments. It is easily applied to all forms of the disease. The most recent observations with a view to the elucidation of the pathology of this disease, are concerned with the thrombosis of uterine sinuses, which goes on in the latter part of natural pregnancy, as well as more extensively, after delivery.

The great barrier to progress in our knowledge of the nature of phlegmasia dolens is the rarity of necropsic investigations, and the sometimes doubtful character of the evidence they afford. Very few unexceptionable *post-mortem* investigations have ever been made in this disease. Such a *post-mortem* inspection must be made in an early stage, and in a patient dying accidentally from some cause unconnected with the disease of the limb. Now, the disease is not only not fatal in an early stage, but it might be asserted that it is not fatal at all—that death, apparently from it, only occurs in complicated cases—in such as run an extraordinary and rare course. In the meantime, then, no theory of the disease can be regarded as established, or as having been shown to be sufficient.

Some modern pathologists believe that there

are varieties of phlegmasia dolens dependent on its origin in disease of the lymphatics, in disease of the veins, or in areolar inflammation. This subdivision has strong arguments in its support, but they are far from being conclusive; and it cannot be used in practice, nor made the basis of any separate description of the varieties, which should be held by the advocates of this view to be distinct diseases. Whilst cases of obstruction of the veins with œdema are common, cases of obstruction of the lymphatics with œdema are probably rare; and neither of these obstructions, nor both of them, can as yet be made to account for all the phenomena of phlegmasia dolens. The distinctive characters claimed for the cases of lymphatic obstruction are the absence of pain, absence of lividity or blueness, and the presence of hyaline lines, indicating the course of distended superficial lymphatics. But it requires only a very limited experience in the disease to be convinced of the insufficiency or frequent inapplicability of this distinction during life.

Symptoms.—As a rule phlegmasia dolens is preceded by a slight access of feverish phenomena, seldom by a distinct rigor. The pyrexia soon becomes slight or disappears. It is only in severe cases, while rapidly progressing to a climax, that the temperature of the affected part has been observed to be raised.

*Premonitory symptoms.*—Premonitory symptoms are frequently absent, indeed generally so; but there is sometimes an indefinite malaise, or even feverishness, for a day or two, before the pain in the limb is complained of. Another premonitory symptom is described, but it also is certainly not always present—namely, pain and tenderness in the region of the womb, especially affecting that side of it corresponding to the limb about to be affected.

*Invasion.*—The first announcement of the disease is generally pain and tenderness in the groin, along the course of the femoral vein, or in the ham along the course of the external saphena. In these situations the thrombosed vein can frequently be felt, but not invariably, for sometimes the tenderness, sometimes the swelling, prevents its being made out; and sometimes this thrombosis is absent, at least in parts where it can be felt through the skin. Soon the pain and tenderness extend over the whole affected parts, which may be the whole limb, and often a feeling as of aching in the bones is complained of. The pain is sometimes along the internal saphena vein, which may be traced by the finger till it dips to join the femoral.

Simultaneously with the complaint of pain, or within a day or two after it, swelling appears, which gradually spreads and increases in hardness. This swelling is not like ordinary œdematous or anasarcous swelling in the sensation it communicates to the hand of the physician, or in the history of its commencement and progress. When it commences, and again as it disappears, it may be, comparatively to its perfect state, soft, and it may pit on pressure; but when, a few days after its appearance, it is fully developed, it is elastic, and nearly as hard as a solid india-rubber ball, and does not pit on pressure. The swelling may appear at once all over the limb, but frequently it commences above and spreads downwards. Sometimes the inverse course is followed. It not rarely affects only the lower parts of a limb, very rarely the upper parts only. It does not affect the lower more than the upper surface of the limb. It rounds off the figure of the limb, but does not distend the skin or destroy the form so entirely as a huge anasarca. Occasionally there is an erythematous blush over parts of the limb, but this is not common, and it may be confined to a narrow surface along the course of a subcutaneous vein or lymphatic.

In a characteristic and fully developed case, such as is frequently observed in the puerperal state, the limb presents a remarkable appearance. The swelling affects the labium and hip and the whole limb. The form of the limb is partly retained, but its features are all rounded and nearly lost in the swelling. Its colour is pale or sallow, like that of a dead limb, and hence the disease is called 'white leg.' But besides being pale, it is glossy, as if greased over; or, more clearly, its surface resembles that of polished marble, and the disease is sometimes called 'marble leg.' In the milder cases the swelling is less, is softer, and may be confined to a part of the limb.

The limb may be kept in an extended attitude, or it may be slightly flexed at the joints. Movement of it causes much suffering, and the power of voluntary motion is almost completely lost while the disease continues.

After the disease has lasted nine days or thereabouts, it generally makes no further progress, but recedes, the pain and swelling diminishing. The rate of this recession varies very much, being probably more or less directly in proportion to the restored permeability of the vessels. In a favourable case several weeks may elapse before the disease disappears, whilst in others the cure may be further or even indefinitely delayed.

Sequelæ, Complications, and Prognosis.—The most frequent sequela of phlegmasia dolens is persistent aching of the limb, increased by cold and damp weather, and by derangement of the general health, as well as by exercise. Another is a tendency to œdema of the ankles, or a persistent œdema in that situation. Sometimes the limb remains deficient in muscular power. Rarely, the limb is not only powerless but wasted. And in some very uncommon cases it is the subject of a great hypertrophy of the cellular tissue, or elephantiasis, simultaneous with muscular wasting; and the elephantiasis may be complicated with more or less extensive and intractable ulceration. Such cases probably result from permanent destruction of large vascular passages; and, falling into surgical hands, demand occasionally treatment by amputation.

The disease is sometimes, not frequently, complicated by other affections, or by aggravations of some of its conditions. Among such occurrences are inflammation and suppuration of the intrinsic joints of the pelvis, erysipelas, limited abscesses (periphlebitis), diffuse suppuration of cellular tissue, gangrene of any part or of a varying amount of the entire lower portions of the affected limb. These complications or aggravations cause much danger to life, and in this respect their influence varies according to circumstances. But there are other complica-

tions or aggravations which are more often fatal. They may be summed up in the terms embolism and pyæmia, and are the consequences of detachment of a thrombus in the femoral, or in still larger veins, or of a more slow breaking up of blood-clots into *débris*, more or less puriform, which enters the circulatory current.

Diagnosis.—The diagnosis of phlegmasia dolens requires no discussion. The disease can scarcely be confounded with any other if its history is taken into consideration: only, it is necessary to remember that œdema with phlebitis or accompanying varicose veins may somewhat resemble it.

Treatment.—The treatment of phlegmasia dolens should be both constitutional and local. The former has no special points, being varied according to the circumstances of the case, and the views of the practitioner. Generally some opiate is required to procure sleep, and Dover's powder is a favourite form for its administration. Local treatment is very important. The limb is to be kept at rest, either in an extended or flexed position, as may prove most comfortable. It should be fomented several times daily, if not constantly. This may be effected by the flannel bandage wrung out of hot water, precautions being taken for the protection of the patient and bed from damp. The fomentations are sometimes made anodyne by using decoctions of poppy-heads or otherwise. Sometimes infusion of chamomile flowers is valued as a fomenting medium. Leeches are sometimes applied along the course of an inflamed vein; but their utility is, to say the least, often doubtful.

After the acute stage of the disease is past the sequelæ have to be dealt with. Of these the most frequent are aches, swelling, œdema, and muscular weakness; and for these the most efficient, but by no means invariably successful, remedies are frictions, bandaging, and faradisation. After all active disease has disappeared, and after danger of the moving of thrombi has passed, the patient should diligently resume the use of the leg. No exact statement can be made of the time at which the danger of embolism is passed. It may prove suddenly fatal thirty-seven days after delivery.

Persistent local hardness and tenderness, probably periphlebitic, may be treated by gentle frictions with a mixture of mercurial and belladonna ointments. In using frictions of all kinds the danger of dislodging a thrombus is not to be overlooked. J. Matthews Duncan.

**PHLEGMATIC TEMPERAMENT.** *See* Temperament.

**PHLEGMON** (φλεγμαίνω, I burn—as a medical term, glow, am inflamed).—Synon.: Fr. *Phlegmon*; Ger. *Entzündungsgeschwulst*.—The term phlegmon is almost disused now in English medical literature. It is still employed by the French. Abernethy defines phlegmon as the 'most violent kind of inflammation,' 'attended with heat, redness, throbbing, pain, and swelling,' such as 'generally takes place in a good constitution.' Older writers describe it as a 'tumour or apostume against nature, engendered of defluxion of blood, and of colour red and hard.'

Nélaton describes simple or circumscribed phlegmon and diffuse phlegmon. He says: 'Phlegmon is generally defined as inflammation of the cellular tissue; but surgeons have restricted the sense of the word, and only apply it to inflammation of the free cellular tissue, that is to say, of that which is placed immediately beneath the integuments or which surrounds the different organs.' The diffuse phlegmon of the French writers is the phlegmonous erysipelas of the English. *See* Erysipelas. Marcus Beck.

**PHLEGMONOUS.**—A term applied to extremely acute inflammation of the cellular tissue, spreading widely, and accompanied by great exudation, with brawny hardness, intense redness, heat, and pain. If unrelieved by treatment, phlegmonous inflammation tends to terminate in gangrene. *See* Erysipelas.

**PHLYCTÆNA** (φλύζειν, to be hot).—A small vesicle, containing an aqueous or serous fluid, and not exceeding in bulk the diameter of a pea, as in sudamina, miliaria, and herpes. The term is sometimes also used in connexion with ophthalmia.

**PHLYCTIS** (φλύζειν, to be hot).—A vesicle or blister, averaging in size the hemisphere of a hazel-nut or walnut, and filled with serous fluid. Phlyctis is the Greek synonym of bulla, and is applicable to the large vesicles or blisters of pemphigus or pompholyx. *See* Pemphigus.

**PHLYZACIUM** (φλύζειν, to be hot).—A hot or inflammatory pustule. The term phlyzacia is applied to acute pustules with an inflamed base, such as those of ecthyma and smallpox.

**PHOSPHATIC DIATHESIS—PHOSPHURIA—PHOSPHATIC CALCULUS.**

1. **Phosphatic Diathesis.**—Ætiology.—Phosphoric acid in the urine is derived directly from the food, and also from oxidation of the waste albuminoid tissues of the body. The daily excretion by the kidneys amounts to about 50 grains, being greatest after the ingestion of food, especially vegetable food.

Characters and Composition.—Phosphoric acid in the urine is always found combined with potash, soda, lime, magnesia, and ammonia. These salts, variously associated, are held in solution by the acidity of healthy urine, and this acidity is probably chiefly due to the acid phosphate of soda. Where this acidity, from any cause, is greatly diminished or destroyed, then a deposit of the phosphates takes place; but this deposit by no means shows that any excess is present. Careful quantitative analysis, under strict precautions as to diet, can alone detect excess or deficiency; but, clinically, this is of less consequence in that no constant symptoms are produced by excess or deficiency, and the real importance to the practitioner lies in the fact of feebly acid or alkaline urine leading to their deposit only.

The two most common forms of phosphatic sediment are—(1) the *triple phosphate of ammonia and magnesia*, and (2) the *amorphous phosphate of lime*.

(1) The *triple phosphate* crystallizes in the

form of transparent triangular prisms with bevelled ends. The deposit has a white appearance, but more frequently it shows as a slight flocculent cloud in the urine, resembling mucus, or as an iridescent pellicle on the surface. The urine is either faintly acid or alkaline; and boiling gives rise to an opaque cloud, which is instantly dissolved by a drop of nitric acid. It not unfrequently co-exists with deposits of uric acid, urates, or oxalate of lime; and also in dense urine with an excess of urea.

(2) *Amorphous phosphate of lime* is only found as a deposit in alkaline urine. Microscopically it shows as pale granules or spheroids, sometimes resembling the dumb-bells of oxalate of lime, sometimes the pale urates.

A third form of phosphatic deposit, the *stellar phosphate of lime*, is but rarely met with. It was first noticed by Dr. Hassall, who considered it to be a biphosphate; it crystallises in minute rods, which are gathered into sheaf-like bundles, or grouped in stars and fans. The clinical importance of this deposit is not well understood. Dr. W. Roberts has met with it in cases of diabetes, phthisis, and chronic rheumatism, and the writer has recently found it in a diabetic patient, and also in one convalescing after ovariotomy.

Symptoms.—Deposit of phosphates takes place in many diseases—diseases often of an opposite character, and having no pathological resemblance—for example, in acute cerebritis; towards the close of cases of pleurisy, pneumonia, and rheumatic fever; in certain periods of typhoid fever; and in acute mania. But it may be taken as proved that there is no morbid condition, characterised by definite and constantly occurring symptoms, and accompanied by the deposit of phosphates in the urine, which can be entitled to the designation of a 'diathesis.' Prout's description of phosphatic diathesis is merely that of ammoniacal urine. Golding Bird associated the deposit with symptoms of irritative dyspepsia, hypochondriasis, and temporary exhaustion of the nervous power; symptoms which are not unlike those said to be characteristic of the so-called oxalic acid diathesis. Remembering, however, that phosphatic deposit does not necessarily or frequently mean excess, but depends on diminished acidity or alkalinity of the urine, it will be more profitable to notice this latter condition.

The urine becomes neutral or alkaline from the presence of either fixed alkali—potash and soda, or of the volatile alkali—ammonia. The continued or frequent presence of alkaline urine from *fixed alkali* denotes grave disorder, generally characterised by debility, anæmia, and nervous dyspepsia; it may and does occur in the course of many, even acute, diseases; it represents an altered condition of blood and nutrition; but it is not typical of any one malady or diathesis, nor, so far as analytical investigations have yet gone, is there any clear evidence of the truth of the theory, that excess or deposit of phosphates, and alkaline urine, are the result of increased cerebral action or of brain-disease.

Urine rendered alkaline from carbonate of *ammonia* is always accompanied by deposit of both forms of the phosphates. The alkalinity is the result of decomposition of the urea; there is the peculiar ammoniacal odour, reaching sometimes to intense putrid fœtor. This decomposition is supposed to be due to the presence of pus or mucus acting as a ferment; but this will not apply to those cases in which no pus or mucus is present, and it is probable that in many instances the putrefaction is produced by germs conveyed into the bladder by the catheter. Ammoniacal urine is always indicative of lowered vitality, either from age or spinal injury or disease; it points to no altered condition of blood or constitution, but is the result of local disease. The phosphates which are so freely thrown down are the triple phosphate and the amorphous phosphate of lime; they are readily deposited on any pre-existing nucleus, whether it be a stone, a clot of blood, a roughened ulcerated portion of bladder, or any foreign body; but without this pre-existing nucleus it but rarely, if ever, happens that concretions form.

Treatment.—As there is no real phosphatic diathesis requiring special management, it follows that the treatment should consist in removing the cause of the alkalinity of the urine from *fixed* alkali. The two most common causes are dyspepsia, and nervous and general debility. In those cases of chronic vomiting and irritable dyspepsia in which the urine loses and recovers its acidity several times daily, no special remedies addressed to the state of the urine can be of any avail. The mineral acids have long been relied on for restoring the natural acidity of alkaline urine; it seems certain, however, that they have no special or direct influence, but simply act beneficially by their indirect tonic effect on the system. Phosphoric and benzoic acids may slightly add to the acidity of the urine, and opium and belladonna in certain conditions of nervous irritability are known to have the same effect; but speaking generally, the mineral, vegetable, and acid tonics are required in almost all cases, and with them the usual adjuncts, namely, good air and exercise; the cold sea-water bath; a well-selected generous diet, largely composed of animal food; and relief from anxiety or overwork.

For alkalinity and phosphatic deposit depending on *volatile* alkali, it must be remembered that in this state the urine is almost always secreted acid. The local disease which causes it must, if possible, be remedied—a stone should be removed; an atonic bladder emptied at stated intervals by the catheter, and washed out with disinfectants, if necessary; but the vital strength always needs to be upheld by rest, good diet, and tonics.

2. **Phosphatic Calculus.**—Description.—Phosphate of lime calculi are sometimes formed in the kidney, but much more frequently phosphatic stones are a secondary deposit on some pre-existing nucleus. They form dense or porous white layers, frequently showing the glistening crystals of the triple phosphate on the surface. Such masses are soluble in acids, insoluble in alkalis or water, friable, and fusible. They develop rapidly, and may reach an enormous size.

Treatment.—When of moderate dimensions phosphatic calculi may be easily removed by lithotrity; but, as it is often difficult to insure the removal of every minute particle, and as

they are often accompanied by chronic cystitis and deficient expelling power of the bladder, recurrence is not infrequent, and the ultimate result unfavourable. WILLIAM CADGE.

**PHOSPHORUS, Poisoning by.**—SYNON.: Fr. *Intoxication Phosphorée*; Ger. *Phosphorvergiftung.*

Phosphorus acts as a poison only when in the form of yellow, common, or soluble phosphorus; in the allotropic form of red or insoluble phosphorus it is inert, either as a therapeutic or as a toxic agent. Poisoning by phosphorus may be either *acute* or *chronic.*

Acute poisoning by phosphorus has recently become not uncommon in this country. On the Continent phosphorus, in the form of the tips of lucifer matches, is frequently used for suicidal purposes. In England phosphorus is most commonly taken in the form of 'rat paste' or 'phosphorus paste,' a vermin-destroyer composed of butter or other fats and phosphorus, coloured with Prussian blue. Chronic phosphorus-poisoning from the inhalation of phosphorus vapours has long been recognised.

ANATOMICAL CHARACTERS. — These are well-marked, and consist of extreme fatty degeneration of the liver, and frequently also of the gastric mucous membrane, kidneys, and cardiac muscular fibre. The liver is also greatly enlarged and white; and the organ frequently takes fire on the mere application of a spirit-lamp flame. On microscopical examination the organs affected are seen to be infiltrated with granular fatty matter, soluble in ether; the gastric tubuli are also filled with granular fat; and the striated muscular fibre has more or less completely lost its normal appearance, and been converted into a similar granular material.

SYMPTOMS.—1. *Acute Phosphorus-Poisoning.*—On swallowing a phosphorus mixture a disagreeable taste is perceived, which is occasionally followed by a burning sensation in the throat, gullet, and stomach; and speedy vomiting. But these signs of the local action of the poison may be either absent, or altogether inconsiderable. At any rate, as a rule, these and the diarrhœa and colicky pains described by some writers, soon pass off, leaving the patient apparently nearly well; though a careful examination may reveal a small, feeble pulse, and when the patient is questioned, the existence of obscure wandering pains may be admitted. In the course of a few days—usually two, three, four, or five—the patient becomes listless, dull, and slightly jaundiced. There is much headache and sleeplessness, together with a general febrile condition, gradually passing into a 'typhoid' state; increasing jaundice; scanty, high-coloured, biliary urine; and a quick and very feeble pulse. Muttering delirium supervenes; there may be violent vomiting of yellow, biliary mucus; and the patient gradually sinks, and dies after a day or two, or perhaps three or more, of acute disease, and usually within a week of the administration of the poison. Death may occur, however, at any period, from one or two to eight or ten days, after a fatal dose of phophorus, which may, perhaps, be taken as half a grain for an adult person.

Variations from the above course of symptoms may be noted. In one class of cases the symptoms betoken a predominance of nervous action. Thus there are cramps and pains in the limbs, great prostration and faintness, convulsions, and, finally, coma. In another class, occasionally observed, hæmorrhagic symptoms are prominent, such as bloody vomits and hæmorrhagic diarrhœa. As an early symptom a phosphorescent condition of the vomited matters, and, more rarely, of the urine, may be noted; and in nearly all cases a peculiar garlicky odour of the breath is perceptible. The phosphorescence or luminosity of the rejected matters is of course best seen in the dark. If the phosphorescent condition of the vomit exist, this permits of no mistake in the diagnosis; but if this condition be absent, the garlicky odour of the breath, and an enlarged condition of the liver, greatly aid in the diagnosis.

2. *Chronic Phosphorus-poisoning.* — Chronic phosphorus-poisoning consists in poisoning by phosphorus vapours. Workers in common or yellow phosphorus exhibit a singular form of disease, from which workers in red or amorphous phosphorus are exempt. This consists in caries of the teeth and necrosis of the lower jaw, which appear to be set up by the direct access of the phosphorus vapours to the part, since those persons only are affected who suffer from decayed teeth.

PROGNOSIS.—This is in all cases very unfavourable, and no general rules can be laid down respecting it.

TREATMENT.—We know but little respecting this. Good results appear to be obtained from the administration of a magma of magnesia, and the use of mucilaginous drinks. The best results, however, have followed the administration of oil of turpentine, which some regard as a specific antidote to phosphorus. It may be given in doses of 10 to 20 minims, frequently repeated.

The chronic form of the disease, which has led to horrible suffering and deformity, may be prevented by the use of red instead of yellow phosphorus in the making of matches. The use of inhalers, and the impregnation of the atmosphere with the vapour of oil of turpentine, are also preventive measures of great service.

THOMAS STEVENSON.

**PHOTOPHOBIA** (*φῶς*, light, and *φόβος*, fear).—Dread or intolerance of light; a symptom, more or less constant, of most forms of inflammation of the eye. In its most pronounced character it occurs in what is called 'strumous ophthalmia,' or phlyctenular keratitis. It is, however present in all forms of inflammation and ulceration of the cornea, in iritis and cyclitis, and more rarely in choroiditis and retinitis. It is also often met with in many diseases of the nervous system, in cerebral irritation, meningitis, cerebritis, &c., and in many pyrexial states. As an ophthalmic symptom, it may occur in eyes perfectly blind, and is probably due to the irritation of the ciliary nerves by light. *See* EYE AND ITS APPENDAGES, Diseases of.

**PHOTOPSIA** (*φῶς*, light, and *ὄψις*, vision).—The subjective sensation of flashes of light, or luminous spectra, due to an abnormal state of some part of the special nervous apparatus of

the visual sense. It is a modification of the special sensibility, and, like photophobia, may occur in blind eyes. *See* VISION, Disorders of.

**PHRENIC NERVE, Diseases of.**—SYNON.: Fr. *Maladies du Nerf phrénique*; Ger. *Krankheiten des Nerven phrenicus.*—The principal disorders affecting the phrenic nerve are two, namely, 1. **Paralysis**; and 2. **Spasm.**

1. **Paralysis.**—ÆTIOLOGY.—Paralysis of the phrenic nerve, that is, of the diaphragm which it supplies, is rarely due to disease of the nerve-trunk. Its common cause is disease at the origin of the phrenic—the anterior grey matter of the spinal cord at the level of the third and fourth cervical nerves. It is commonly part of acute or chronic spinal myo-atrophy. Paralysis has also been observed by Duchenne in lead palsy. In a few cases the paralysis has been apparently due to cold, supposed to have caused a rheumatic inflammation of the nerve-trunk. In a few cases, also, the nerve has lost its function in consequence of compression in the neck.

ANATOMICAL CHARACTERS.—Degeneration of the trunk of the nerve, wasting of the nerve-fibres, and increase of connective tissue, have been found in cases of disease of the spinal cord. Of the anatomical changes due to other causes nothing is known.

SYMPTOMS.—The evidence of paralysis of the phrenic is inaction of the diaphragm. When one nerve is diseased there is imperfect action on one side, and this may be conspicuous or indistinct. When both nerves are affected, as is commonly the case in central disease, there is an entire absence of the normal protrusion of the abdominal wall during inspiration; there may even be a recession of the upper part of the abdomen, and a bulging during expiration in the same situation. In ordinary breathing the respiratory actions are not quickened by paralysis of the diaphragm, but if any exertions are made the respirations become more frequent, and the extraordinary muscles of respiration are thrown into action. All spasmodic respiratory actions—sneezing, coughing—are performed with less energy. Little inconvenience is experienced unless bronchitis comes on, and then the lessened respiratory power may place the patient in a condition of great danger.

The phrenic nerve is accessible to direct stimulation in the root of the neck, and when it is paralysed, its irritability is usually lost, and the diaphragm can no longer be made to contract. In rare cases, however, the nerve-trunk retains its irritability.

DIAGNOSIS.—The diagnosis of paralysis of the diaphragm is not always so simple a matter as might be supposed. Its action should be looked for not only in deep breathing, but in ordinary respiration. Many persons, if told to 'take a deep breath,' do not put the diaphragm into action at all. In forced breathing the chief extra action takes place in the upper part of the chest, to which most of the muscles of extraordinary respiration are attached. It is probable that the centres for normal and extraordinary breathing are functionally not identical, and that the diaphragm is chiefly represented in the former, so that it does not necessarily act in deep breathing. There is a mechanical reason for this. In the extreme action of the intercostal muscles the thorax is widened to such a degree, that the diaphragm becomes less curved by the movement outwards and elevation of its points of attachment, so that its contraction does not effect much additional enlargement of the capacity of the thorax. Hence, in many persons, without any paralysis of the diaphragm, if a deep inspiration is taken, the epigastrium does not advance; may even recede, in consequence of the movement of the lower ribs. This is especially the case in women, in whom breathing is always less diaphragmatic than it is in men. In them, too, conscious attention to the act of breathing is apt to arrest the action of the diaphragm. The tendency of voluntary breathing is to be costal rather than diaphragmatic, no doubt because the centre for extraordinary breathing, which is chiefly voluntary, is brought partially into action. In a woman under the writer's care, paralysis of the diaphragm was suspected, and during two separate and prolonged examinations not the slightest action could be observed. On a third examination, however, more normal conditions were obtained, and the action of the diaphragm was natural. This is the condition which has been termed 'hysterical paralysis of the diaphragm.'

It must not be forgotten that immobility of the diaphragm may result from other causes than paralysis of the phrenic nerve. In diaphragmatic pleurisy, for instance, its movement is lessened by a reflex inhibitory effect of the pain. In emphysema of the lungs, in which the thorax is greatly widened, the contraction of the diaphragm produces less effect than in health.

On the other hand, when the diaphragm is really paralysed, a doubt may arise as to whether it moves or not. This is due to the circumstance that the movement of the lower ribs may drag forward the abdominal parietes close to them, and so the protrusion due to descent of the diaphragm may be simulated. This is especially the case when the abdomen is collapsed, so that when the patient is recumbent its level is considerably below that of the ensiform cartilage. This movement may be distinguished from that due to the descent of the diaphragm by a little care: the movement is confined to the proximity of the thorax, and there is not the general movement of the abdominal viscera and parietes which results from the contraction of the diaphragm.

PROGNOSIS.—The prognosis of paralysis of the diaphragm is favourable in the rare instances which are due to exposure to cold; rather less favourable in lead-poisoning. It is unfavourable when part of progressive spinal myo-atrophy. When due to acute spinal myo-atrophy (anterior cornual myelitis) the prognosis will depend on the indication afforded by other symptoms of the position of the chief disease, whether the region from which the phrenic nerve arises is gravely or slightly damaged. When paralysed from compression the prognosis depends on the nature and origin of the pressure.

TREATMENT.—The treatment of the paralysis, which is part of the spinal myo-atrophy, is that of the central disease. In all cases causal indications must be met. When due to cold, sina-

pisms should be applied over that part of the phrenic nerve which seems, from any attendant pain, to be chiefly affected. If the nerve has not lost its irritability, it may be faradised systematically. The points to which the rheophores should be applied are one on the neck, just above the scaleni, and one near the diaphragm. A strong current has to be used.

2. **Spasm.**—Spasm of the diaphragm occurs chiefly in the form of hiccup, and as part of the respiratory spasm in hydrophobia, and does not need special description. *See* DIAPHRAGM, Diseases of; HICCUP; and HYDROPHOBIA.

W. R. GOWERS.

**PHRENITIS** (*φρήν*, the mind).—An obsolete term, formerly associated with all forms of acute inflammation of the brain or its meninges, but especially the latter.

**PHTHIRIASIS** (*φθείρ*, a louse).—SYNON.: Pediculosis; Fr. *Phthiriase*; Ger. *Läusesucht.*—This disease of the skin bears the same relation to the pediculus that scabies does to the acarus scabiei.

DESCRIPTION. — There are three varieties of phthiriasis, corresponding to the three species of pediculi that infest the human body. *See* PEDICULUS.

1. **Phthiriasis capitis.**— Phthiriasis affecting the head is met with chiefly in children. The eruption is an artificial pustular eczema, due to the irritation of the insect, and the scratching of the sufferer; in consequence of the sores on the scalp, the superficial lymphatic glands at the back of the neck often become enlarged.

2. **Phthiriasis corporis.**—Phthiriasis of the body is confined to the parts covered by the clothes, and is most developed on the back. It is especially met with in the old and feeble. The lesions of the skin consist of small excoriations and scattered papules, whose tops are seen to be torn and bleeding from the scratching of the sufferer. These bleeding papules give to the eruption its characteristic appearance. In chronic cases the general colour of the skin is darkened from an excessive deposit of pigment.

3. **Phthiriasis pubis.**—This variety of phthiriasis differs little from that of the body, except that it is limited to the regions infested by the crab-louse.

All three varieties of the disease are attended with intolerable itching.

TREATMENT.—Phthiriasis is easily cured by means of an ointment containing one part of the oil of delphinium staphysagria and seven parts of lard.

R. LIVEING.

**PHTHIRIUM INGUINALE** (*φθείρ*, a louse).—One of the synonyms of the *pediculus pubis*, or crab-louse. *See* PEDICULI.

**PHTHISIS** (*φθίνομαι*, I waste).—SYNON.: Consumption; Fr. *Phthisie*; Ger. *Schwindsucht.*

DEFINITION. — Phthisis, or consumption, is the term used to designate a disease characterised by progressive wasting of the body; persistent cough, with expectoration of opaque matter and sometimes of blood; loss of colour and strength, shortness of breath; hectic fever, night sweats, and diarrhœa; these symptoms being associated with certain well-marked pathological changes in the lungs, namely, the formation of consolidations in a granular or diffuse form; which either undergo caseation and disintegration, leaving behind excavations in the lung-tissue; or, becoming indurated and shrinking, cause contraction of the affected organ.

ÆTIOLOGY.—The conditions which give rise to phthisis are varied and diverse; but by tracing out their mode of action on the individual, we arrive at a twofold arrangement into *general* and *local* causes. In the *general*, the constitution of the individual, and the functions of nutrition and assimilation, appear to be first involved. In the *local*, the lungs are the primary seat of disease, and changes in their epithelium and parenchyma lead to products of a retrograde kind, through which the lymphatic and vascular systems, and the constitution generally, become infected. The general may be called *constitutional*, and the local *inflammatory*. General causes are those which affect the whole system, such, for example, as family predisposition; fevers and exanthemata; syphilis; insufficient food; alcohol; bad ventilation; climatic influences; dampness of soil; infection; &c. Amongst local causes are to be enumerated inflammatory affections of the lungs and pleura; trades and occupations giving rise to a gritty atmosphere; and injuries to the chest. We must bear in mind that a cause may act in two capacities, locally and generally; for instance, scarlatina may cause enlargement of various lymphatic glands throughout the body, and render the individual liable to the formation of tubercle generally; or scarlatina may leave behind it consolidation of portions of the lungs, which may result in caseation, whence may arise tubercular infection of the system.

The most important causes of phthisis will now be individually discussed.

1. **Family predisposition.**—The influence of heredity as a cause of phthisis cannot be doubted; it has been abundantly proved by observation and experiment on both man and the lower animals. The term *family* predisposition is substituted for *hereditary* predisposition, because the latter, from its limitation to direct descent, necessitates the omission of the evidence of disease in collateral relatives. The statistics of the first *Brompton Hospital Report* on this point, as compiled by Dr. Quain, who contrasted them at the same time with the statistics of insanity, and those also of Drs. Cotton and Fuller, show that among the lower classes hereditary predisposition (that is, where one or both parents were affected) was traced in 25 per cent. The writer's researches among 1,000 cases of the upper classes show 12 per cent. of direct hereditary predisposition, and 48 per cent. of family predisposition.

Family predisposition is more common among women than men, in the proportion of 57 to 43, which may be accounted for by the more sedentary and less invigorating life of the former, The transmission of phthisis is more common through the mother than through the father; but where one parent alone is affected, fathers transmit more readily to sons, and mothers to daughters than the converse. Dr. Pollock lays stress on the influence of hereditary predisposition in the acute forms of phthisis, and states that out

of 179 cases only 34 could positively declare absence of family taint. The principal effect, however, of family predisposition is to be seen, *not* in any peculiarity of symptoms, but by the influence it exercises over the age of attack. The writer's researches show clearly that this is much earlier in patients so predisposed than in others; and in females this influence is greater than in males.

2. **Local infection.**—Chronic inflammatory affections of organs and textures leading to the formation of caseous centres.—Examples of this class may be found in cases of impetigo in children, leading to enlargement and caseation of the cervical glands; in the so-called scrofulous diseases of the joints; and in psoas and lumbar abscess.

3. **Acute febrile diseases.** — Continued fevers, measles, and scarlatina act partly by exhausting the system, and partly by bequeathing to the individual the legacy of caseous matter either in the lungs or glands, which prove the centres of subsequent tuberculisation.

4. **Syphilis.**—Syphilis, by its debilitating influence, predisposes to phthisis; but it also appears to act as a cause capable of developing two forms of the disease, namely (1) limited consolidation with no great tendency to excavation; and (2) a form of laryngeal phthisis, characterised by ulcers in the larynx and in the pharynx, difficult to heal except by specific treatment. This last has been called syphilitic disease of the larynx; but as in the writer's experience it is always associated with tubercle in the lungs, he thinks that the phthisis is caused by the syphilis, and should be classed accordingly.

5. **Debilitating conditions.**—Miscarriages, unfavourable confinements, over-lactation, insufficient food, and alcoholism are recognised causes; but the cessation of habitual discharges is not so clearly admitted. The stoppage of the discharge of a fistula *in ano*, and the drying up of an old ulcer, are frequently followed by an outbreak of tuberculosis in the lungs.

6. **Mental depression.**—This is often mixed up with other causes, but occasionally acts alone.

7. **Bad ventilation.**—Dr. Guy has shown that consumption is more rife among persons of indoor occupations than among those employed out of doors; this being true not only of the lower classes, as printers, compositors, and tailors, but also of the tradesmen who live in hot gaslit shops, and often sleep in miserably ventilated bedrooms. These are not ill-fed, but are nevertheless twice as liable to consumption as the upper classes. Hawkers and other outdoor trades, though much exposed to catarrh, are shown to be less liable to consumption than indoor workers. Of nearly 6,000 cases of phthisis admitted into the Brompton Hospital during ten years, two-thirds had indoor occupations. Amongst them milliners, sempstresses, and tailors furnish the largest quota, who all live in close rooms, to which they are almost entirely confined.

8. **Climatic influences.** — A moist atmosphere is more favourable to the development of consumption than a dry one; and, while we recognise that the combination of cold and moisture is one of the principal causes of the inflammatory forms of the disease in Great Britain, the testimony of Dr. Guilbert indicates that a combination of heat and moisture, as exemplified in the littoral of Peru, in the West Indies, &c., produces an acute form of consumption, largely prevalent in those districts, attacking the abdominal organs in addition to the lungs.

9. **Dampness of soil.** — The researches of Dr. Buchanan have demonstrated that the death-rates from phthisis in the districts of Surrey, Kent, and Sussex, depend to a great extent on the geological formation of the soil; for while in the light and sandy strata, deaths from phthisis are rare, in the heavy impermeable ones, in which clay predominates, the mortality from this cause is high. The conclusion that wetness of soil is a cause of phthisis to those living on it, has been confirmed by the Registrar-General of Scotland, and by Dr. Bowditch of the United States; the latter testifying that this law holds good, not only as regards villages and towns, but even as regards individual houses—the houses on clay becoming the foci of consumption, while others but slightly removed from them, but on a dry soil, wholly escape.

10. **Inoculation.**—From the time of Laennec until the present, experiments have been carried on by numerous observers to ascertain whether tubercle is, or is not, inoculable; and the results of these experiments prove that in guinea-pigs and rabbits tubercle can be produced artificially by the insertion underneath the skin, not only of tubercle, but of various other materials, such as pus, putrid muscle, and diseased liver, taken from non-tubercular subjects. There was nothing specific in the results of the inoculations, for the materials most efficient in producing artificial tubercle were those taken from low pneumonia, pyæmic abscess, &c.; while human tubercle, phthisical sputa, foul pus, and putrid muscle were less successful. No results were obtained from the material of acute sthenic pneumonia, from pneumonic and bronchitic sputa, healthy abscess, diphtheritic membrane, syphilis, typhoid intestine, and cancer. It was found by Dr. Burdon Sanderson that tuberculosis might be induced in the guinea-pig by the insertion of a cotton thread under the skin, but if the seton was steeped in carbolic acid, no tubercle was produced. To ascertain the results of mechanical injury without exposure to air, the scapulæ of guinea-pigs were fractured subcutaneously. No tuberculosis resulted. It is evident, from these experiments, that tubercle is not so potent for infective purposes as many other materials, and especially those of a septic nature, such as pyæmic pus and putrid muscle; and this is still further borne out by the seton experiments, where the purification of the wound by carbolic acid appears to have prevented the infective process, as also by the cases in which the scapulæ were fractured. These facts warrant the conclusion that tuberculosis is closely associated with pyæmia, and among animals the difference between these two diseases would appear to be one merely of degree; for Dr. Sanderson found that while the injection of pus into rabbits produced death from pyæmic abscesses in forty-eight hours in some, in others the slower results of tuberculosis followed. This process generally consisted in the development of granulations at the seat

of inoculation, from which the neighbouring lymphatics became infected, and this led to a dissemination of the products through both the lymphatic and circulatory systems.

Chauveau found that heifers might be infected by mixing tuberculous matter from their own species with their food. Bollinger confirmed this experiment, but found that carnivora could be fed with impunity on fresh tuberculous matter taken from animals of the bovine species.

11. **Infection.**—The idea of infection being a cause of phthisis still prevails in the South of Europe, and has lately been revived by Dr. Budd in England. The evidence of the Brompton Hospital negatives the idea of a contagion such as is present in small-pox or scarlet fever; for it has been demonstrated that the percentage of acquired phthisis occurring among the resident staff of the institution is less than that of most general hospitals. An infective influence may arise from the expectoration of advanced cases of phthisis or of bronchitis, which should be counteracted by antiseptics and good ventilation. That phthisis may be communicated from husband to wife is strongly maintained by Virchow and many English physicians, and Dr. Hermann Weber has lately indicated by some striking cases the danger of pregnancy to the wife of a consumptive.

Cohnheim, who appears to have confirmed by his own experiments the doctrine of specific infection, holds, in opposition to the above views, that the test of tubercle is its inoculability, and prefers this to any structural test. He considers that tubercular particles are conveyed by means of organisms to the lungs, thus affecting the pleura and bronchial glands, and later the larger bronchi. The infection of the intestinal canal arises from swallowing the sputum. Cohnheim believes strongly in infection through suckling, and states that he has noticed scrofulous inflammation of the mouth and pharynx arise in that way. Weigert maintains that meningitis has been caused by infection through the upper nasal passages.

12. **Local causes.** — The local causes of phthisis are those which injuriously affect the bronchi and air-passages, causing large epithelial proliferation and various inflammatory lesions, followed by thickening and induration of the alveolar walls, and in time caseation or fibrosis.

*Bronchitis*, or bronchial catarrh, after existing for many years in a person, may extend more deeply into the alveoli and pass into a so-called catarrhal pneumonia, producing consolidation and eventually excavation of the lung. Bronchitis was the origin in nearly 12 per cent. of the writer's 1,000 cases; and a very large number of the poorer classes trace their disease to neglected catarrh.

*Pneumonia* is a fruitful source of phthisis, though some forms are more capable of giving rise to it than others. In croupous pneumonia, where the exudation is fibrinous, and has but little epithelium or leucocytes intermingled with it, absorption generally follows, if the patient's constitution be in a fair state, and few of these cases go into phthisis; but where leucocytes and epithelial products largely predominate, absorption is slow, the pneumonia becomes chronic, and thickening of the alveolar wall and caseation of the epithelium take place, accompanied sooner or later by the signs and symptoms of consumption. A third form of pneumonia which may originate consumption is pleuropneumonia, or interstitial pneumonia, where the inflammation extends to the pleura, and the interlobular connective tissue is largely increased. Many instances, too, of phthisis have arisen in empyema, through absorption of the purulent fluid, the channels being the elaborate network of lymphatics which the pulmonary pleura has been shown by Dr. Klein and others to contain.

13. **Trades and occupations giving rise to a dusty or gritty atmosphere.**—The constant inhalation of particles of flint, iron, coal, hard clay, and even of cotton, flax, and straw, as is the case in certain trades, such as stonemasons, fork- and needle-grinders, colliers, potters, cotton-carders, chaff-cutters, and others, has been shown by Dr. Greenhow to induce the disease. The various irritating particles have been detected microscopically and chemically in the lungs, where they appear to cause great irritation, followed by thickening of the bronchi and subsequent induration of the lung-tissue, with increase of pigment. Intermingled in the consolidations are found grey and yellow tubercle, and also extensive cavities, proving the identity of the disease with phthisis.

14. **Injuries to the lungs.**—Injuries to the lungs through wounds are somewhat rare causes of phthisis; and their action is chiefly by inducing the inflammatory processes, chronic suppuration and abscess, or induration with shrinking of the lung-tissue.

Anatomical Characters.—The morbid anatomy of phthisis, acute and chronic, presents considerable difficulties, partly from the variety of pathological products, and partly from the complete disorganisation of the normal structure, and even of the invading growths. It often happens that several processes have been going on in the lungs simultaneously, each of which brings about the work of destruction by a different method and at a different rate, some by obstruction through consolidation, others by caseation and excavation. On the predominance of one or the other depends the future of the lungs, for we sometimes see one pathological element which has invaded a large portion of these organs superseded and gradually destroyed by another of more recent date, but endowed with a higher degree of vitality.

In advanced cases the lungs are for the most part devoid of vesicular tissue, and consolidated by various kinds of growths and exudations. They are also occupied by cavities, varying in size from a microscopic point to one of so large a capacity that the lung is converted into a mere bag of thickened pleura. The cavities are of every conceivable form and shape, sometimes oval and well-defined, lined with a secreting membrane, at other times irregular, sinuous, anfractuous, and presenting on section either an uneven surface, from which portions of the wall stand out like the columnæ carneæ of the heart, or a very rugged surface, on which ulceration and suppuration appear to have done their worst; but, whatever be their shape or their size, they indicate the destructive character of

the retrograde processes by which the disease called pulmonary consumption is characterised.

The consolidations vary, but all partake more or less of a tubercular character. In some cases the lungs are disseminated with miliary tubercles from apex to base, the intervening tissue being free from excavation, and either engorged or consolidated with red hepatization, or sometimes apparently healthy; in others no trace of miliary tubercle can be found, but the lungs are consolidated throughout by caseous pneumonia, containing cavities of various sizes. Sometimes there are aggregations of the different forms of tubercles—white, grey, and yellow in the same lung—while the opposite lung may be entirely clear; sometimes a lung may be shrunk to the size of a fist, its pleura thickened, its lobules invaded with white fibrous bands, its tissue converted into an iron-grey structure by fibroid growth. All these, and many other diverse morbid appearances, are found in the lungs of persons dying of phthisis, and we must classify and distinguish them, first describing their naked-eye appearances; secondly, their histological phenomena; thirdly, we must consider the changes which take place in other organs of the body; and fourthly, we must indicate the pathological relation these all bear to one another and to the disease generally.

The principal pathological elements and changes are:—1, grey and dark granulations, or miliary tubercles; 2, white granulations; 3, yellow granulations, or yellow tubercle; 4, caseous masses, or yellow infiltration; 5, grey infiltration, or catarrhal pneumonia; 6, red hepatisation; 7, fibrosis; 8, cretaceous masses; 9, fibrinous nodules (blood-residues); and 10, vesicular emphysema.

1. **Grey granulations, or miliary tubercles.**—These vary in size from a millet-seed (hence the name miliary) to a hemp-seed, scattered throughout the lung-tissue. When first formed they are greyish-white, more or less transparent, and will yield to firm pressure; but after a while they either undergo caseation, being converted into the yellow variety, or losing moisture, become drier and harder, attaining the consistency of cartilage. At the same time pigment is absorbed by them; the colour passes from a light to a dark grey, and to black; the granulations simultaneously drying up and becoming obsolescent. These hard grey granulations are not uncommonly found after death in old persons, and are an evidence of tubercle having appeared at some period of their lives, and of its having afterwards become obsolescent.

More commonly these grey granulations increase in number, and form aggregations or clusters, much resembling bunches of berries, standing out in bold relief against the healthy or congested lung-tissue; their principal locality being the upper lobes of the lungs, and especially the posterior portions. In some instances this aggregation spreads quickly and extensively, and the whole lungs become so densely packed with miliary tubercle that it is difficult to find any portion of the respiratory surface free. This rapid formation of tubercle is sometimes sufficient to cause death by asphyxia, but more commonly the intense crowding of the pathological products gives rise to their destruction. Caseation commences in the centre of the groups, and cavities subsequently form. The discrete form of grey tubercle is generally found in acute miliary tuberculosis, and does not vary much in size with the different organs attacked by tubercle, as the peritoneum, pleura, &c. This identity of form suggests very forcibly the hyperplasia of some normal structure present in all the several organs, rather than an adventitious growth.

2. **White granulations.**—These formations are more opaque, and softer than the grey, and differ from the latter, as we shall hereafter see, in the arrangement of the histological elements, there being more epithelium and less reticular growth in them than in the grey variety.

3. **Yellow granulations.**—Yellow granulations or yellow tubercles exist in greatly varying sizes, from a pin's head to a pea. They are opaque, soft, granular, amorphous, easily separated from the adjoining tissue, and sometimes surrounded by a circle of pearly, transparent material. Dr. Wilson Fox describes a form of yellow tubercle among children dying of acute tuberculosis, which is with difficulty separated from the parenchyma of the lungs; but in adults it is generally easily removed, the grey granulations with which it is so often associated remaining behind.

Yellow granulation is by far the commonest form of tubercle, and its frequent occurrence in phthisis led Laennec not unnaturally to the conclusion that it was a *sui generis* production, essential to the disease. It seldom occurs alone, but is ordinarily associated with the grey and white granulations, sometimes forming with them racemose groups in various parts of the lung, chiefly in the upper lobes. At other times it is the centre of an affected portion, groups of grey granulations apparently radiating from it, thus naturally leading to the supposition that a species of local infection has been set up by the yellow or caseous mass. These groups, as they increase, exercise great pressure on the various granulations composing them and on the intervening lung-tissue, depriving them of nutrition, and thus causing death of the part by caseation. The decayed portion is gradually removed either by absorption by the lymphatics, or by expectoration; in the latter case cavities result. Careful study of one of these tubercular groups will demonstrate that the yellow tubercle is but a later condition of the grey, in which caseation has commenced; and that the cavities, large or small, in its neighbourhood are the result of the softening and removal of the yellow tubercle, and whatever lung-tissue happens to be intermingled with it.

4. **Caseous masses.**— Caseous masses and yellow infiltration are identical in constitution with the yellow tubercle, but differ in size and form, arising sometimes from the aggregation of a number of yellow granulations, but oftener from the rapid caseation of inflammatory exudations; and in this case whole lobes become affected with what is then called yellow infiltration.

5. **Grey infiltration: catarrhal pneumonia.**—This change is identical with the 'gelatinous infiltration' of Laennec. The pressure on the walls of the alveoli caused by the epithelial aggregations, as well as the inflammatory

exudation, gives rise to obliteration of the vessels and consequent caseation, and in this way large tracts of grey pneumonia are converted into yellow masses and subsequently become excavations.

6. **Red hepatization.**—The result of ordinary croupous pneumonia is often found associated with one of the above forms of tubercle, but more commonly occurring in the lower lobes, than in the upper. *See* LUNGS, Inflammation of.

7. **Fibrosis.**—Fibrosis is largely present in phthisis, but preponderates in (1) cases originating in pleuro-pneumonia, pleurisy or pneumonia; and (2) in cases of long duration. Fibrosis is the great element of the contractile process, whereby the lungs are reduced considerably in size, cavities of large capacity are cicatrized, and caseous masses encapsulated; and sometimes grey tubercle is converted into this tissue.

A lung invaded by fibrosis is reduced in size, and presents on section a dense, tough, and very hard structure, resembling cartilage in its resistance to the knife. All traces of the alveoli have disappeared, and nothing remains but a dark grey or black fibrous material, into which run long bands of whitish fibrous tissue, harder than the darker portions. The pleura is generally thickened, and the septa apparently arise from it and from the connective tissue at the root of the lung, which is also largely increased. Fibrosis is found in limited portions of the lung, in nearly all kinds of phthisis, forming the scars of contracted cavities, or tending to isolate caseous masses and tubercular aggregations. When miliary tubercle becomes converted into fibroid growth, the resulting tissue is of short duration, owing to its deficiency of blood and lymph-vessels; caseation consequently takes place at various points, and it thus perishes.

8. **Chalky masses.**—Cretaceous or chalky material is found in chronic cases, lying in small masses in various parts of the lungs, chiefly at the apices, in the neighbourhood of old cavities or caseous tracts, and generally encapsulated by fibroid tissue.

9. **Fibrinous nodules.**—These bodies have been noticed by Dr. Reginald Thompson in cases where large hæmoptysis has occurred. These vary greatly in size, and consist of inhaled blood: they are situated at portions of the lung where inspiratory action is strongest. When first found, they appear as white nodules with a zone of red colouring matter; and even in the old specimens some traces of blood in the form of crystals of hæmatine are to be found. Microscopically they are shown to consist of fibrin and red corpuscles, filling the alveoli and even penetrating the alveolar wall. The masses eventually either (1) separate from the surrounding tissue through contraction of the fibrin, leaving a capsule adherent; or (2) owing to admixture with bronchial secretion or some such septic matter, they soften into a mortar-like material, and are got rid of by expectoration; or (3) if the nodule be sufficiently large, and there be no exit for its contents, the result is the formation in time of a species of cavity filled with glairy yellow fluid, resembling honey.

10. **Vesicular emphysema.**—Two kinds are noted in the lungs of phthisical patients. *Acute vesicular emphysema* is found distributed throughout the lungs of those dying of acute tuberculosis; and *chronic local emphysema* occurs in connection with chronic tubercular masses, and specially in the neighbourhood of cicatrized cavities. The vesicles are few in number, and often as large as a hazel nut, and are generally to be found at the apex, or along the anterior border of the lung.

MICROSCOPICAL CHARACTERS.—In cases of tuberculosis and phthisis, the following histological features (as classified by Dr. Green) are present in the lungs. The amount of importance to be attached to each element has not yet been determined.

1. *Exudation.*—Exudation of fibrin and leucocytes into the alveoli, resembling that of croupous pneumonia, the fibrillation not being quite so distinct, nor the coagulum so abundant. In a large number of cases of phthisis, the lung-consolidation consists of exudatory products mingled with epithelial proliferation; and in some of the most acute instances, these two processes have constituted the only lesion.

2. *Epithelial accumulations.*—An accumulation of large epithelial cells may be found within the alveoli. These are generally large, spheroidal cells, about four or five times the size of a leucocyte, containing granular matter, and a nucleus and nucleolus. Some smaller ones are also observed, indistinguishable from leucocytes. Within the alveoli also are found the so-called 'giant cells,' which are held by Hering to be lymphatics cut across; by Friedländer to be the basis of tubercle; by Klein and Green to be derived from the alveolar epithelium, by fission or excessive development. These appear at first as spheroidal masses of faintly granular protoplasm, reaching $\frac{1}{200}$th inch in diameter, with numerous nuclei—sometimes as many as thirty, and bright nucleoli. After a while they increase in size, and send out branched processes, from which are developed other smaller protoplasmic masses, so that a branched reticulum is formed round the original giant-cell, connecting it with other giant-cells. These branches are often directly continuous with the lymphoid or adenoid network of the alveolar wall, to be presently alluded to, which forms a circle round the giant-cell system. Giant-cells are not found in the earlier stage of tubercle-development, and appear after some of the products of exudation have been absorbed. They are devoid of any vascular supply, and are consequently subject to caseation, having in such cases previously undergone a peculiar transformation into a fibrillar material. Giant-cells are regarded by Green as a product of low vitality, incapable of forming organised tissue; where the protoplasm grows, the nuclei multiply, but the highest manifestation of cell-life—division of the cell—does not take place.

3. *Interalveolar growth.*—This is a thickening of the alveolar wall by a small-celled lymphoid tissue, consisting of minute cells not larger than a leucocyte, separated from each other by a very delicate reticulum. This growth appears to commence in the walls of the alveoli and terminal bronchi, first in the form of a few lymphoid cells, the network appearing later, and has been demonstrated by Sanderson to be a hyperplasia of

the adenoid tissue already existing in the lungs; for it must be borne in mind that lymphatics and lymphoid tissue are largely present in these organs, and that the alveolar wall is considered one of the densest lymphatic plexuses of the whole body.

The small-celled tissue spreads rapidly through the alveoli, invading the walls of the capillaries, the peribronchial and perivascular sheaths, diminishing by pressure the calibre of the vessels, and in time obliterating them, and thus giving rise to necrobiosis by caseation and ulceration of the surrounding tissues. The growth fills up the alveoli, and thus infiltrates whole tracts of the lung, which in time become cut off from both air and blood supply. This either degenerates by caseation, giving rise to the formation of cavities; or the cells become more spindle-shaped and branched; the reticulum more fibrinated; and then gradual fibrosis of the nuclear tissue takes place. Owing, however, to the disappearance and obliteration of the vessels, this tissue is not properly supplied with nourishment, and soon undergoes caseation.

4. *Interlobular growth.*—Increase in the interlobular connective tissue resembles the process prevailing in the liver, kidneys, and other organs during chronic disease, and is not necessarily associated with consumption. This feature is most marked in cases of inflammatory origin, or where the disease is of very long standing; and the result is best seen in the large fibrous septa often accompanying the bronchi and great blood-vessels, as is specially exemplified in fibroid phthisis. Microscopically it is difficult to distinguish between the interlobular tissue and the alveolar adenoid growth in their early stages, both being richly cellular; the main differences being the situation of the former around the lobules, and in the neighbourhood of the great air and blood-vessels, whereas the latter is found in the alveolar wall and smaller bronchioles. The interlobular tissue is not so liable to retrograde changes, owing to the vascular supply being less liable to obstruction and obliteration; and, again, the alveolar growth has a more delicate reticulum of fibres.

**Changes in the bronchi, pleuræ, and bronchial glands.**—The *bronchi* show, in many cases, catarrh of the mucous membrane, giving rise to a richly cellular secretion, which forms the greater proportion of the expectoration of phthisis, as the principal lesion, and extending in acute cases throughout the whole bronchial tree; but in more chronic forms being limited to the bronchi leading to the affected lobules. A second and more important change is the infiltration, noted by Rindfleisch, of the sub-epithelial connective tissue by large cells characteristic of scrofulous inflammation, and very difficult of absorption. The mucous membrane appears swollen and opaque; the epithelium may be shed; and if the sub-epithelial infiltration disintegrate, small ulcers are formed. A third change is the infiltration of the peribronchial tissue, and the proliferation of lymph-follicles in the walls of the smaller bronchi, owing to transmission of infective substances from the bronchi through the lymphatics. The bronchi from these changes become reduced in calibre, and consequently the adjoining ones, as noticed by Grancher, are often dilated through the action of increased air-pressure on their walls.

In laryngeal phthisis ulceration is to be found in the bronchi, as in the larynx, the changes in which will be presently stated under the head of *Laryngeal phthisis.*

The *pleura* is often adherent over the region of tuberculisation, when the formation has taken place slowly, and is comparatively superficial. It is often considerably thickened, as in fibroid phthisis, to the extent of three-quarters or one inch diameter, the layers being sometimes separated, as Dr. Douglas Powell has shown, by a gelatinous material, consisting chiefly of connective tissue.

The pleura, peritoneum, arachnoid, and even the pericardium, may be the seats of miliary tubercle in the most acute form of phthisis, namely, miliary tuberculosis; but it is generally noted that the lungs are the first organs attacked, and it is extremely rare for tubercle to exist in any organ without being also present in the lungs.

The *bronchial*, cervical, mesenteric, and other *glands* undergo various changes. In many, and especially in advanced cases, the bronchial glands enlarge and become deeply pigmented; in others they seem to partake of the changes proceeding in the lungs; they become affected with grey tubercle, and caseate, and occasionally cretify, the cretaceous material being, as a rule, in the centre of the gland, though the reverse is occasionally the case, and the calcareous matter forms a shell over the whole gland (*see* Bronchial Glands, Diseases of). The other lymphatic glands, especially the mesenteric, are liable to similar changes.

**Other organs.**—The stomach and intestines in protracted cases become greatly attenuated, all the coats being thinned and wasted, and in many cases are found to have undergone lardaceous degeneration, which is a common cause of diarrhœa in phthisis. Where the diarrhœa has been very persistent, it is common to find extensive ulceration of the jejunum, ileum, cæcum, and large intestine, extending even to the sigmoid flexure and rectum, the cæcum being earliest attacked, and generally in a more advanced stage than the small intestine. The ulcers vary much in form and extent; in some instances they are circular, clearly cut depressions; in others, and this is the commoner form, they present large, raised, irregular edges, with fæces adherent to their ragged surfaces, and can be often seen through the attenuated external wall of the intestine. The peritoneal coat, as a rule, is thickened in their neighbourhood, and thus perforation of the intestine prevented. The earlier stages of this process appear to be:—miliary tubercles form in the submucous coat, not only in the solitary glands and Peyer's patches, but scattered throughout the submucous layer, appearing as shining granules through the epithelium; yellow points of caseation become visible in some parts, and small abscesses form in others, the latter appearing to have their seat in the solitary and agminate glands; and, later on, these discharge, leaving ulcers of different forms. Ulceration of the large intestine pene-

trates very deeply, and often resembles that of old dysentery. Perforation rarely occurs, on account of the thickening of the peritoneal coat taking place outside the ulcers, but occasionally it does occur, causing fatal peritonitis.

The liver is rarely normal, but generally undergoes either fatty or lardaceous degeneration. The spleen is softened, and very commonly lardaceous. The kidneys are not generally affected, but where albuminuria has prevailed towards the close of the disease, fatty or lardaceous changes occur. The heart is usually small, and the muscular tissue pale, and very often in a state of fatty degeneration (Quain). Fatty growths may be found on the surface.

Pathology.—The nature of tubercle has long been a subject of discussion. In the sixteenth century two forms of tubercle (scirrhous and caseose) were recognised, showing that even at this period a distinction had been drawn between grey and yellow tubercle. Later on, the similarity of the changes occurring in the tubercular masses to the softening of scrofulous glands, led Portal to conclude that tubercles were engorged lymphatic glands situated at various parts of the lungs, the engorgement terminating in suppuration. Laennec applied the term tubercle to miliary and yellow granulations, as well as to grey and yellow infiltration, but considered that it was a *sui generis* production, unconnected with inflammation. Broussais, Andral, and Cruveilhier assigned an inflammatory origin to tubercle, the latter considering that tubercle is the result of chronic inflammation of the lymphatics of the lungs. At length Virchow restricted the term 'tubercle' to the grey granulation, which, according to him, originates in the connective tissue, and is of a cellular nature. Rokitansky, Dr. C. J. B. Williams, and others considered that tubercle is principally an exudation from the blood-vessels, the different varieties depending on the kind of exudation, and on the part played by the leucocytes. Dr. Williams does not exclude the additional action of the local tissues, the connective tissue, the epithelium, and the adenoid tissue of the lung; but he assigns the principal part to the exuded materials from the blood-vessels, especially to the leucocytes, regarding the lymphatic cells in the small-celled tissue as identical with leucocytes in their nature and action, and that when increased in their number in denser masses, they constitute grey tubercle. This may pass into the state of yellow tubercle by the process of caseation, which consists of fatty degeneration and disintegration of these masses, entirely destroying their remaining vitality. Drs. Sanderson and Wilson Fox have demonstrated the grey tubercle to consist of the small-celled adenoid tissue with such epithelial accumulations as may be imprisoned in the course of its growth; and the latter holds that this small-celled tissue is to be found in all forms of tubercle and in consumptive infiltrations. Dr. T. H. Green maintains the existence of all four classes of histological elements as enumerated above, in the lesions of phthisis, and that the small-celled tissue is not typical of phthisis, as it may appear in chronic inflammations of various organs, as of the kidney and liver. In some of the most rapid instances of acute phthisis (not acute tuberculosis) he can detect nothing but the products of exudation so closely packed as to cause their own breaking down. At the same time he admits the large part played by the adenoid growth in grey granulations. Charcot, after careful histological study, strongly advocates the unity of phthisis, and affirms that in caseous pneumonia he finds, as in grey granulation, two zones—first, a central region, consisting of little else than exudation-products and caseous *débris*, in which reagents can bring to view fibres of lung-tissue; and, secondly, a peripheral region ('*zone embryonnaire*') made up of adenoid growths and giant-cells. He considers that the last two elements are the basis of tubercle, which is always a peribronchial product, and that caseation does not take place without their being present. Charcot points out that croupous pneumonia occurs in tubercular lungs, and clears up, leaving no residue behind; and argues that pneumonia alone cannot produce the caseous masses.

Though great difference of opinion thus appears to exist as to the relative parts played by exudation and adenoid growth in the pathology of phthisis, it will not be difficult to deduce some general conclusions which may elucidate many of the difficulties.

The part played by inflammation in phthisical lungs, in spite of Charcot's doctrine, is very large, and we may conclude that grey and yellow infiltration are varieties of the pneumonic process, probably of a low type, with, as Dr. Fox remarks, 'that invasion of the alveoli by the small-celled tissue which leads to the obliteration of the capillaries and slow necrobiosis of the part involved.'

Of the inflammatory products found in phthisis, the fibrinous or easily absorbed element is scarce, and the corpuscular, or cellular, which is not easily absorbed, is common; and this last element, in order to be absorbed, has generally to pass through the process of caseation.

The absorption of caseous matter by the lymphatics is attended by a considerable amount of irritation, and thus we get adenoid hyperplasia or tuberculosis. This may be *local*, as when we see a group of miliary nodules surrounding a caseous centre, the rest of the lung being apparently free; or *general*, infecting the lymphatics of the lungs, and it may be of other organs, as is seen in acute tuberculosis. The future of grey tubercle depends to a great extent on its rate of production, and its relation to blood-vessels. When not clustered closely together, and when unaccompanied by inflammation, it may gradually dry up, and even in time be converted into fibrous tissue; but if, as is usually the case, increase of the adenoid growth leads to obliteration of the capillaries, we have caseation and excavation, with fresh local infections.

The two principal factors in the pathology of phthisis then are *irritation* and *infection*:—

*Irritation.*—Under this term may be included the various inflammatory processes and other local agents, which affect the alveolar wall in proportion to the intensity of their action.

*Infection.*—Infection is either local, through inflammatory processes, as the result of irritation;

or from general state of system, as in cases from family predisposition, where the lymphatics are primarily affected.

It, therefore, appears most probable that the various pulmonary processes—the exudation of leucocytes, the formation of giant cells, the adenoid hyperplasia, are all indications of some general blood-crasis, manifesting itself chiefly in the lungs, on account of the large circulatory area involved, but not necessarily confined to their limits. We may suppose that under these circumstances the blood has a tendency to form and exude cells, which grow and do not develop into tissue, but die and caseate, and in this state irritate the lymphatic system, and the pulmonary lymphatics in particular. We must bear in mind that the increase of the adenoid tissue takes place *after* the exudation, the epithelial proliferation, and formation of giant-cells. What the irritating quality of the blood is, whether chemical or histological, and why cellular exudations should be less easily absorbed than fibrinous, are problems still to be solved.

Symptoms.—(*a*) *First stage.*—The symptoms of pulmonary phthisis in the first stage may be thus summarised :—Cough, becoming more persistent; mucous expectoration ; loss of colour and strength ; emaciation ; night-sweats; sometimes loss of hair; pulse somewhat quickened, though this is not invariable ; and a temperature rising above the normal in the afternoon, and sinking below it in the morning. M. Peter has noted in many cases a rise in temperature on the affected side during this stage; and with regard to the general temperature of the body, though slight pyrexia is often present, tubercle-formation is quite possible without any rise of temperature, or may even be marked by a depression, as Surgeon-Major Alcock and others have shown. Pain in the upper parts of the chest is occasionally present; and the number of respirations are generally increased, though this depends on the amount of tuberculisation proceeding. Some hold that dyspnœa is an early symptom and precedes all others, but the writer has found quite the opposite—that patients do not notice their breath to be short until their lungs are seriously involved. Disturbance of the digestive powers, and considerable irritability of the intestinal mucous membrane, with a red streak on the gums, is noticeable in some, though chiefly in the acute forms. The tongue becomes white, the bowels torpid, and the urine scanty. The most constant of the above symptoms are the persistent cough, with mucous expectoration, and the progressive emaciation; and in many cases so obscure are the beginnings of the disease, that these are the only symptoms discoverable.

*Physical signs.*—The physical signs, after the first stage, depend to a great extent (1) on the number and aggregation of the miliary tubercles ; (2) on the amount of consolidation they give rise to ; and (3) on the irritation which their formation causes in the lung.

As a rule tubercle-formation commences at the apex of one lung, and is detected by the presence of certain physical signs in the supra-scapular, supra-clavicular, or sub-clavicular regions, the signs extending downwards at a later date. The signs vary much in particular cases, but consist at the first in an impairment of the ordinary respiratory murmur by a species of crepitation, differing from the pneumonic crepitation chiefly in its more scattered character, in its being audible with both inspiration and expiration, and in its crumpling nature. Many authors, however, maintain that an earlier sign is the 'wavy' breathing (T. Thompson), or '*respiration saccadé*' of the French. Accompanying this is increased vocal resonance and bronchophony, with more distinct conduction of the cardiac sounds; and percussion discovers dulness of varying shades in one of the above-mentioned regions. When a certain definite amount of consolidation has taken place some impairment of the mobility of one side of the chest may be noticed: this is to be detected under the clavicle, where, if any adhesion of the pleura exists, there may be some flattening. Another significant sign is the dry friction-sound, audible generally in the supra-scapular and scapular regions, and indicating limited pleuritis from a nodule of tubercle formed immediately below the membrane. The sub-clavian murmur, much dwelt on by old authors, is too uncertain to be depended on. The dulness usually appears first above the scapula, next over the sternal end of the clavicle, and gradually extends downwards, being limited generally for a considerable period by the third rib.

A careful comparison must be made between the two sides of the chest, and often between different portions of the same side, as otherwise the slighter shades of dulness, and the minor differences in the respiration-sounds, which characterise the presence of tubercle in the lung, will escape notice.

When the crepitation and the wheezing—which may be considered as indicative of irritation in the pulmonary tissue, caused by tuberculosis—have subsided, prolonged expiration, and certain varieties of tubular sound, show condensation of the lung-tissue around the neighbouring bronchi; and a certain amount of dulness is to be detected.

(*b*) *Second and Third stages.*—The symptoms which accompany the second stage, or that of softening of tubercular masses and their subsequent excavation, are by no means uniform. Many authors associate this stage with marked signs of pyrexia, with copious night-sweats, and increase of cough and emaciation ; but this is not always the case, for, according to the writer's experience, the process may go on with even subnormal temperatures, and with gain of weight ; but as fresh formation of tubercle often accompanies the softening process, some of the above symptoms, which have been assigned to softening, may be due to the tuberculisation and pneumonia accompanying it. The symptoms which should be most depended upon for the detection of softening are—increase of cough, and expectoration of a yellow colour, occasionally streaked with blood. If the expectoration be carefully collected and boiled with an equal volume of caustic soda, of the strength of 20 grains to the ounce, and the sediment then placed under a moderate magnifying power of the microscope, delicate filaments of yellow elastic tissue, of hook-like shape, or else exhibiting the charac-

ters of the alveoli, may be detected. The sputum chiefly consists of pus, with 2 to 4 per cent. of albumen, and a large proportion of phosphates. Pouchet found monads and bacteria; and Koch has recently described the peculiar bacilli, believed by him to constitute the virus of tubercle. Dr. Ehrlich has given an elaborate process for showing these bacilli in the sputum. (*Deut. Med. Wochensch.* May 6; and *Med. Times and Gaz.*, May 27, 1882.) *See* BACILLI, in Appendix.

*Physical signs.*—The signs which these changes give rise to are often obscure. The percussion-sounds vary; sometimes there is an increase of dulness, possibly due to pneumonia of adjacent lobules; at other times, hyper-resonance, as if air had taken the place of the expectorated masses. In all these cases much depends upon the situation of the lesion. The formation of a cavity deep in the lung, and far from the chest-walls, may take place without being detected, except by the expectoration; whereas the formation of a similar one on the surface gives rise to unequivocal signs. Auscultation reveals—where formerly bronchophony and fine crepitus existed—crepitation of a very coarse character, commencing with a *click* sound, and after a while developing into a *croak*. When this last note has been reached, loud tubular sounds become audible on coughing, and we soon get the sounds characteristic of a cavity. The great distinguishing features of these moist sounds of softening are their variety, their short duration, and their concentration over one small portion of the lung. In phthisis, crepitation much more commonly signifies tubercle-formation or pneumonia than it does softening of already formed tubercular masses. The formation of a cavity is generally followed by regular morning expectoration, usually opaque, and nummular in form, and in the majority of cases, unless interfered with by treatment, by the usual consumptive train of symptoms, if these have not already appeared. These are — night-sweats, slightly elevated temperature at night, and rapid loss of flesh, strength, and colour. The drawn look of the face, the hectic spot on the cheek, the pearly white colour of the sclerotic, the clubbing of the fingers, and other signs which mark the confirmed consumptive, generally belong to this stage, and all more or less denote blood-infection from the lung-products, sometimes even simulating pyæmia.

The weakness of voice, so common in chronic phthisis, is distinct from the total aphonia of laryngeal phthisis, and has been shown to be due to granular degeneration of the muscles of the larynx. Marcet has shown that in phthisis the muscles generally undergo degeneration.

The history of a cavity follows one of four courses. *See also* CAVITY; and VOMICA.

1. It may remain patent, secreting pus, like a chronic abscess, but not increasing in size.

2. It may enlarge by caseation and ulceration going on in its walls, by which process blood-vessels may become exposed. In this case the expectoration becomes more nummular and abundant, containing quantities of lung-tissue and remains of bronchi; and excavation may in time convert the lung into a mere pleural bag, devoid of lung-tissue, with what remains of the bronchi opening into it. The physical signs attending this increase in size are amphoric breathing, and often hyper-resonance on percussion, or cracked-pot sound; and the voice and cough may be accompanied by metallic tinkling, especially if the communication with the bronchi is narrow.

3. It may open into the pleura, and cause pneumothorax or pyopneumothorax. That this does not occur oftener is owing to the adhesive pleurisy which so often accompanies the early consolidations of phthisis, especially if the tubercle be superficial. *See* PLEURA, Diseases of.

4. It may contract, and the sides approaching each other form at length a firm, tough cicatrix, causing a stretching of the surrounding tissue, and often considerable displacement of the neighbouring organs. This is the natural cure of the third stage of phthisis, and is evidenced in most cases by a flattening of the chest-wall, chiefly in the infra-clavicular space, a disappearance of the cavernous sounds, and a substitution of deficient or harsh breathing, and sometimes of healthy sounds over the seat of the cavity. Percussion often discovers that the sound lung is drawn across the median line to the affected side; and if the cavity be in the left lung, the heart and stomach may be displaced upwards, the former organ being generally tilted towards the axilla, the apex describing the arc of a circle, of which the centre is the commencement of the aorta. If the cavity be in the right lung, we may expect the liver to be drawn up, and the heart displaced to the right of the median line, reaching occasionally beyond the right nipple. Contraction of a cavity always takes place towards a fixed point, which is sometimes an adhesion of the pleura, but more generally the root of the affected lung; and in this way the remarkable vagrancy of the physical signs is explained; for it is not unusual to find the cavernous sounds audible above the scapula, long after they have ceased to be heard in the sub-clavicular region, and again in the inter-scapular regions after they have ceased to be audible in the supra-scapular fossa.

Of these destinies of a lung-excavation, the two first are undoubtedly the commonest. Where the cavity remains quiescent, and no fresh tubercle-formation takes place, the patient may live on for years, with only the inconvenience of regular expectoration and occasional dyspnœa, and preserve the appearance of actual health. Where a cavity continues to increase by further ulcerative processes, tuberculosis soon attacks the opposite lung; and this organ passing rapidly from consolidation into excavation, the cough and expectoration increase, hectic fever becomes more frequent, the patient reaches an extreme state of emaciation, the adipose tissue disappears from all parts of the body, the temporal and malar bones become prominent, the jaws are sharply defined, the scapulæ, ribs, and sacra all stand out, as if, as is really the case, they were only covered by skin, and the patient becomes to all appearances a mere skeleton. By an all-wise arrangement a kind of balance seems to be maintained between the diminished requirements of the body and the mass of the blood, for this

latter is reduced in bulk in proportion to the lessened respiratory surface, and the individual thus gradually dwindles and sinks.

In the last stage of phthisis various symptoms appear indicative of the disorganisation the blood has undergone, and the manifest lowering of the standard of life. Thromboses may arise in the veins of the extremities; œdema of the ankles and feet ensues; bed-sores form on those parts where the pressure is greatest, as, for instance, on the hips, buttocks, and sacrum; and aphthæ appear on the tongue and fauces, and when removed are succeeded by a fresh crop, rapidly spreading round the hard palate, buccal surface, and gums. Ulceration of some part of the mucous membrane of the mouth and pharynx is not uncommon, the part affected being generally the edge of the tongue, or the buccal surface in the region of the back molars. Ulceration of the soft palate rarely occurs except in connection with syphilis. Near the end profuse sweats follow the swallowing of all fluids. The breathing becomes quicker, and expectoration more and more difficult. Diarrhœa prevails at this stage, and often proves fatal before the pulmonary lesions have reached their furthest development.

Death may occur in several ways, either—(1) by apnœa, from inability to expectorate; (2) by thrombosis of the pulmonary artery, inducing lividity and dyspnœa; (3) by pneumothorax; or, (4) by exhaustion, the heart's action gradually failing, the patient being utterly prostrated, either by the wasting course of the disease, or by the attendant diarrhœa. Hæmoptysis may cause death, either by collapse from loss of blood, or by suffocation through the blood rapidly filling the air-cells.

Some of the principal symptoms of phthisis require a fuller description.

**Temperature, pulse, and respiration.**—The *temperature* of phthisis is both pyrexial and subnormal, its varieties depending partly on the amount of tuberculisation and inflammatory process going on, and partly on the extent to which the constitutional powers are depressed. The high temperatures are due to the former, the low ones to the latter cause. The range extends from 106° F. or 107° F., noted in acute phthisis, down to 90·5° F., observed by Lebert. The writer has seen morning records as low as 91·6° F. In many cases of quiescent phthisis in the first and third stage, the observations are for the greater part of the day subnormal, and only reach the healthy standard in the afternoon. It is even possible for tubercle to form, and for softening and excavation to take place, without any rise of temperature.

Where, however, tubercle-formation is accompanied by elevation of temperature it is post-meridian, and by no means continuous in character, the phenomena being as follows:—The rise commences after 2 P.M. and continues till 8 P.M., when the maximum, which may attain 103° or 104° F., is reached. A fall then begins, and continues till 4 or 5 A.M., when the minimum, which may be as low as 94° F., but is generally about 95° F. or 96° F., is attained. After this a gradual recovery takes place, and by 10 or 11 A.M. normal temperatures are reached. During the process of softening the post-meridian rise appears to be maintained later in the day, the maximum being reached at 10 or 11 P.M. In active cases in the third stage, where excavation is proceeding or extending, and where also fresh tuberculosis may be taking place, the thermic chart approaches more closely to that of suppuration and pyæmia, and shows great extremes, the highest and lowest temperatures of phthisis being noted at this stage. The rise commences soon after noon, and continues till 5 P.M., or even till 10 P.M., when the maximum of 103° to 104° F. is reached, and a fall rapidly follows, 95° F. and 94° F. being very commonly reached before 6 A.M. Then recovery sets in, and normal records are observed about 10 A.M. The chief characteristics of the temperature in phthisis are—(1) the post-meridian form of its pyrexia; and (2) the remarkable fall at night to subnormal figures, showing collapse of the vital powers.

The occurrence of hæmoptysis does not generally affect the temperature, unless a large amount of blood has been inhaled into the air-cells. Under these circumstances catarrhal pneumonia is set up, and the temperature remains elevated until its subsidence; or, if it does not subside, but gives rise to secondary tubercle, the chart will assume the pyrexial character of acute tuberculosis. Night-sweats, as a rule, lower the temperature for the time, but they are not to be regarded as a consequence of the pyrexia, as they are noted sometimes in non-pyrexial cases, but rather as a flux from the skin, due to loss of power in its vaso-motor system. The influence of diarrhœa on the temperature depends entirely on its form and causation. Where it depends on acidity of the primæ viæ and dyspepsia, it exercises no influence; where it arises from lardaceous degeneration of the intestines, and is accompanied by dropsy, a lowering of the standard may be looked for. Where, as is generally the case, it is due to intestinal ulceration, a decided rise of temperature takes place, generally in the evening, succeeded by equally well-marked morning remissions, if the ulceration is extensive. Albuminuria, from whatever cause arising, tends to lower the temperature, and the more so as the kidneys become more deeply involved, the blood is more disorganised, and dropsy supervenes.

The *pulse* varies greatly, according to the form of the disease, and the amount of lung-surface involved. In the greater number of cases of chronic phthisis its character is weak, regular, and little above the normal standard. In cases of acute disease, it has a frequency of 100 to 140, but its rise, as a rule, follows, sometimes after a long interval, that of the temperature. Considerable changes may take place in the lungs without any rise of pulse.

*Respiration* varies according to the amount of lung-surface involved, being normal in early quiescent stages, and rapid in cases of extensive advanced disease. Nevertheless in acute phthisis and acute tuberculosis, the respirations are generally rapid, even before the lungs are largely obstructed, and in these cases there is a definite pulse-respiration ratio. In phthisis generally this cannot be said to exist, but the observation

of the number of respirations is of far more importance than that of the pulse.

**Diarrhœa.**—Diarrhœa has a great influence on the course of the disease, and tends more to weaken and emaciate the patient than the harassing cough, the persistent pyrexia, or the drenching night-sweats. In the first stage an opposite condition, namely, constipation, prevails, but in the third stage it is tolerably common and very obstinate in character. The diarrhœa varies in intensity, according to its cause. Sometimes it proceeds from (1) acidity of the primæ viæ and consequent indigestion, and is trivial in character. Sometimes it is due to (2) atony of the intestines, and partakes of the character of a flux, like night-sweats; (3) in other cases it is due to lardaceous degeneration of the intestines, especially of the small intestine. The diarrhœa is not always very profuse in these last cases, but it is very persistent, and not uncommonly accompanied by vomiting of a very obstinate kind. Lastly (4) it may originate in ulceration of the intestines, as has been described. Here the diarrhœa is very persistent, the stools ochrey and soft, and sometimes streaked with blood; the patient often complains of pain in the abdomen, referred to the seat of ulceration, and experiences tenderness on pressure. This is usually found over the ileo-cæcal valve, but in cases of extensive ulceration the writer has traced it throughout the whole of the ileum, into the colon (ascending, transverse, and descending), and the sigmoid flexure. Flatus and a tympanitic condition of the abdomen is often present in extreme cases, but generally after intestinal perforation. The diarrhœa prevails most at night, but in advanced instances continues day and night, and exhausts the patient greatly.

**State of the Blood.**—The principal changes in phthisis are a diminution of the red corpuscles (Malassez), and of the hæmoglobulin (Quinquand); and an increase in the number of leucocytes, and in the proportion of fibrin and phosphate of lime. In advanced cases aggregations of granules, varying in size from $\frac{1}{10}$th to $\frac{1}{2}$ a red corpuscle, have been observed. The masses are often large enough in size to occupy a third of the field of the microscope; and when observed for one or two hours at a temperature of 98° or 100° F. these granules appear to develop into organisms, and to move about in the blood. Their nature and function are quite unknown.

VARIETIES.—We have hitherto traced the course of a typical case of consumption in its various stages, and we must now draw attention to the different forms the disease includes, always premising that while they differ in symptoms, in prognosis, and in duration, they cannot be erected into distinct pathological varieties, as they are merely forms of the same disease, and between each is to be found every kind of anatomical and clinical connection.

The following table gives the principal forms:—

I. *Acute.*—1. Acute tuberculosis. 2. Scrofulous pneumonia, or acute phthisis. 3. Acute tuberculo-pneumonic phthisis.

II. *Chronic.*—4. Catarrhal phthisis. 5. Fibroid phthisis. 6. Scrofulous phthisis. 7. Hæmorrhagic phthisis. 8. Laryngeal phthisis. 9. Chronic tubercular phthisis.

**1. Acute Tuberculosis.**—This term is restricted by the Germans to cases of general tuberculosis where more than one serous membrane is affected with tubercle, in addition to the lung, but it is here used to denote all acute pulmonary cases where miliary tubercle, which has not begun to caseate, is the principal lesion. The history is as follows: a young person of either sex is suddenly attacked with feverish symptoms, pungent heat of body, rapid pulse, extreme oppression, and overwhelming weakness, dry-coated tongue, red at edges, soon becoming brown in the centre, sordes on the teeth and lips, gastric disturbance and diarrhœa, and occasional delirium, the symptoms closely resembling those of enteric fever, for which the disease is often at first mistaken. Cough and slight expectoration come on; fine crepitation and bronchial rhonchus take the place of the ordinary vesicular sounds; and occasionally some dulness is detected over the posterior regions of the chest. The patient wastes rapidly; the breathing becomes more and more embarrassed; the sputum rusty; the crepitation more general and louder. Later on, the symptoms of collapse appear—the pulse becomes more rapid and feeble, the aspect ghastly or livid, cold perspirations appear, and death occurs within a few weeks from the date of the first onset. Or the symptoms may be more cerebral in character, denoting that the meninges are the seat of miliary tubercle. The patient complains of pain in the head, vomiting, and intolerance of light; begins to mutter and to give wrong answers; and then has marked delirium. The aspect is heavy and confused; hyperæsthesia of skin (Empis) appears; and double vision, though squinting is not always noticeable. Granulations can often be detected by the ophthalmoscope in the fundus oculi. Twitchings of the muscles of the extremities and sometimes of the face occur, followed by convulsions, and by paralysis of the sphincters. Dilatation of the pupils and other signs of effusion supervene, and the patient dies comatose. In this variety, as a rule, the temperature remains continuously high (between 100° and 102° F.) but in some instances under the writer's notice it has not risen above 100° F. for the last ten days of the patient's life. After death the lungs are found highly congested and pervaded with miliary tubercle, soft in character, but devoid of caseation; the bronchi full of frothy mucus; and tubercle may also be found in the peritoneum, brain-membranes, or pleura, with effusion into the ventricles. This form is distinguished from capillary bronchitis by the presence of fever; from enteric fever by the different physical signs; from scrofulous pneumonia by the great dyspnœa and scanty expectoration; and by the head-symptoms (when present) from all the above.

Acute tuberculosis is the most fatal form of consumption, terminating in a few weeks or even days, and is characterised by gastric disturbance, the presence of family predisposition (Pollock), and the absence of hæmoptysis.

**2. Acute phthisis.**—Acute phthisis or scrofulous pneumonia, is another very acute variety. The patient, generally young, who may have had cough previously, is attacked with sharp pain in one side of the chest, quick pulse, high temperature, the skin being quite burning to the ear of the auscultator, alternating with night chills

and sweats. The general appearance betokens pneumonia, but the crepitation commences at the apices, extending to the whole lungs, and is not so fine and even as in pneumonia. The cough increases; the expectoration becomes opaque and purulent, containing quantities of lung-tissue; and the temperature assumes the intermittent type. The physical signs show at first gradual consolidation of both lungs, but later on declare excavation to have taken place; and this continues, the patient rapidly wasting and dying in a few weeks. Sometimes the cavity opens into the pleura, which in these cases is rarely adherent, and death ensues by pneumothorax. This form is not quite so hopeless as acute tuberculosis, and the disease may stop short of utter lung-destruction, the patient remaining in a state of crippled respiration and of health for months and even years. The writer has notes of one case lasting three and a half years; another sixteen years and still living. After death the lungs are found more or less consolidated, with adherent pleuræ, the indurations consisting of red hepatisation and caseous infiltration, the latter largely predominating. Excavations abound in all directions, and but little or no miliary tubercle is present. The characteristics of this form, are (1) the acuteness of the disorganising processes, excavation quickly succeeding consolidation; (2) the inflammatory nature of the lesions, and the rarity of miliary tubercle; (3) the occurrence of pneumothorax; and (4) the freedom of other organs from tuberculosis.

3. **Acute tuberculo-pneumonic phthisis.** This is a third variety, which constitutes a connecting link between the above forms, scrofulous pneumonia and acute tuberculosis, as it presents some of the clinical and pathological features of each, resembling the latter in so far that the tuberculisation takes place rapidly in the lungs, and often involves other organs, as, for instance, the intestines; and being more akin to the former in the presence of consolidations of a pneumonic origin, yet differing from them both in that the tubercle aggregates, tends to caseate, and thus to form cavities, through the breaking down of tubercular masses, and not of catarrhal pneumonic products, this occurring while rapid tuberculisation is taking place in another part of the lungs.

4. **Catarrhal phthisis.**—Catarrhal phthisis somewhat resembles the last-named variety, and has its origin in bronchitis which has gradually passed into catarrhal pneumonia. The patient has been subject for years, perhaps, to attacks of winter catarrh, which disappear in summer; and at last, owing to a severe season, or from his being in less favourable circumstances than usual, his cough does not cease, as formerly, but remains persistent, and is accompanied by some purulent expectoration, loss of flesh, and night-sweats. The bronchial *râles*, sonorous and liquid, as they disappear from certain parts of the lung, become more prominent and localised in others, especially under the clavicles, and above and between the scapulæ. The *râles* become coarser, and the sonorous rhonchus assumes a croaking character. Signs of consolidation soon appear, but are never so prominent as in other forms, owing to the temporary emphysema accompanying the bronchitis; the dulness appears in patches over the centres of increased rhonchus; the liquid *râles* diminish, owing to increasing obstruction, and give place to a tubular sound conveyed by the extending consolidation from the larger bronchi, and heard best in situations overlying them, as below the clavicle, and above and within the scapula, in the axillary and middle dorsal regions. The tubular sound has a sharp, whiffing character, and is often unaccompanied by bronchophony, from the consolidation being insufficient, and the bronchial tubes too choked to produce it. If the case goes on unfavourably, the expectoration becomes more abundant, and excavation soon takes place, with the usual symptoms; the patient assumes all the appearances of advanced cavity-phthisis, and the case from this date can hardly be distinguished clinically from those of a strictly tubercular origin. After death the lungs are found to be more or less consolidated, the indurations taking the direction of certain lobules and generally not affecting entire lobes. The indurations are of a grey or yellowish tint, with numerous yellow masses of caseation intervening. Portions of the lung may be found in the first stage of catarrhal consolidation, so well described by Dr. Hamilton, with isolated lobules or groups of lobules of a leaden or purple colour, and the adjoining ones may be emphysematous. Wedge-shaped patches of consolidation can be traced on the pleural surface, exuding on section yellow catarrhal fluid similar to that contained in the bronchi. Numerous excavations of irregular form are seen, but in most instances no trace of tubercle is to be found, though it is occasionally present. The bronchi are generally dilated, and full of purulent matter. This form is more common among the young than the old, and arises from whooping-cough, measles, and bronchitis, the pathology being extension of catarrh from the bronchi to the alveoli, implication of the interstitial tissue, large epithelial proliferation, causing pressure and emptying of capillaries, degeneration and caseation of the alveoli and their contents, and consequent excavation, with occasionally lymphatic infection.

5. **Fibroid phthisis.**—This term, introduced by Dr. Andrew Clark, is applied to cases of which fibrosis is the principal feature. While this process accompanies most instances of chronic phthisis, it specially characterises those in which interstitial pneumonia is present, and entirely modifies their history and symptoms. It is generally secondary to attacks of pleurisy and pleuro-pneumonia, or to chronic pneumonia, resulting from long-continued irritation of the lungs, through the inhalation of dust or grit, as prevails among fork and knife grinders, colliers, and button-makers. Taking the pleuritic origin as an example, the following are the symptoms.

A patient has an attack of pleurisy with effusion, from which he recovers with absorption of fluid; but percussion shows dulness over the whole side and somewhat feeble respiration. The patient experiences dragging pains in the side; a dry, hacking cough, somewhat paroxysmal in character, with little expectoration, continues; and the breathing, always short, becomes still more so on exertion. These symptoms increase, and a few months later we find marked immo-

bility of the affected side, dulness throughout, and now considerable shrinking; the circumference of this side, measuring one or two inches less than the healthy side. On auscultation we notice the breathing to be very deficient in some parts, and in others bronchial, and sometimes cavernous in character; but generally there is everywhere absence of true vesicular breathing. Careful percussion of the opposite side of the chest shows the line of resonance to extend beyond the usual limit, passing to the edge of the sternum, and often an inch or two further; demonstrating that the contraction of the affected lung has caused the healthy one to be drawn across, in order to fill up the void. Other organs are likewise displaced. If the left lung be affected, the heart is tilted, not necessarily upwards, as when a cavity is contracting, but outwards. The stomach rises, its note being audible as high as the fourth rib. The heart is not only displaced, but is uncovered by the retreating lung; and the right auricle and ventricle are clearly distinguished by their pulsations, while the right lung is drawn across to the left side to the extent of one or two inches. If the right lung is affected, the left may be drawn over, and the area of resonance may extend as far as the inner half of the right clavicle, and a line drawn thence sloping towards the middle of the sternum. The heart is transposed, and its impulse may be traced in the fourth interspace on the right side. The liver rises up to the fifth rib, and shrinking of the chest-walls takes place, as on the other side. The pulse may be slow; the respiration often rapid, rising to 50 and 60 per minute. The temperature seldom rises above the normal, and is sometimes subnormal. When the temperature rises over 100° F. it signifies that something beyond fibrosis is going on. The cough is troublesome, and often induces vomiting; and the expectoration becomes more and more difficult, and in time, on account of retention, fœtid. Meanwhile the dyspnœa increases, the other lung becoming involved; signs of obstructed circulation appear; dropsy of the extremities takes place and rapidly increases; the urine becomes albuminous; and the patient dies, either of dyspnœa or of blood-poisoning, his death contrasting strongly with the ordinary termination of consumptive disease. The patient may, however, die of apnœa, without albuminuria or dropsy. After death we find a lung contracted to the size of a man's fist, with enormously thickened and adherent pleura and widely dilated bronchi, with interlobular septa much increased in size and encroaching on the lung-structure, which seems to be replaced by a fibrous hard tissue, in parts mottled with grey, deeply pigmented, and resembling cartilage in its resistance to the knife. Imbedded in this structure are found caseous and cretaceous masses, or again, excavations of various sizes; the walls of these and of the dilated bronchi being rigid and inelastic, from the presence of the fibroid material, and thus affording some explanation of the difficult expectoration and consequently troublesome cough. Besides these changes, we may find the other lung the seat of tuberculosis, though this is not constant; but commonly the bronchial glands are hardened and deeply pigmented. There is often amyloid disease of the liver, spleen, and kidneys.

6. **Scrofulous phthisis.**—This is a variety where consumptive disease of the lung is preceded by, or accompanies, scrofulous affections of various joints, caries of the sternum, ribs, and vertebræ, lumbar and psoas abscesses, otorrhœa, fistula in ano, or, as is most common, enlarged and caseating glands, cervical, bronchial, axillary, or mesenteric. Rindfleisch explains the non-absorption of scrofulous matters by the presence in exudations of this character of relatively large cells with glistening protoplasm, and by the fact that the emigrated leucocytes, which pass from the blood-vessels of the inflamed part into the adjoining structures or into the lymphatics, in scrofulous persons tend to grow larger on their way through the connective tissue, by absorption of albuminous substances. The large size of the cells has been verified by Godlee, Schüppel, Green, and others. Cases of scrofulous phthisis show an early infection of the lymphatic system, and a remarkable correlation appears to be established between the external gland or discharging surface and the condition of the lungs. If the glands are suppurating, or if the fistula is open, or if the carious bone freely discharges, the lung-disease will remain quiescent, and progress may be made towards arrest; but if, on the other hand, any of the above discharges should be checked or cease, the lung-disease passes into fresh activity, making considerable advance and extension. The temperature-course in these cases, if active lung-changes are taking place, is remarkably fitful, showing evening exacerbations of 102° F. to 104° F. and morning depressions of 96° F. to 97° F.; and night-sweats are usually very profuse. Patients of this type lose and gain flesh with great rapidity, owing probably to the pyrexia and fitfulness of the appetite.

Scrofulous phthisis is strongly hereditary: it prevails chiefly among children not exceeding fifteen years, as shown by Pollock, many of these presenting the well-known strumous aspect, the clear complexion, enlarged glands, chronic inflammation of the eyelids, or discharging ears. They are attacked early with hæmoptysis, accompanied by cough and wasting. The course of the disease, probably on account of the relief afforded by the various discharges, is slow, and the patient lives on for a considerable period; but, as might be expected, the development of the individual is slow and often stunted. *Post-mortem* examination generally shows the ordinary destructive lung-changes of advanced tubercular phthisis, with considerable enlargement of the various glands—bronchial, mesenteric, cervical, &c.

7. **Hæmorrhagic phthisis.**—This name is intended to designate, not phthisis arising from the results of hæmoptysis (*phthisis ab hæmoptoë* —Niemeyer), but a form recognised by C. J. B. Williams, Peacock, Hughes Bennett, and the writer, in which large and repeated hæmorrhage is the principal feature, associated with a small amount of detectible disease. It is more common among men than women, in the proportion of five to one: and the period of attack is later than in the ordinary forms, possibly owing to the element of heredity being generally absent.

The patient may have had signs of failing health before the hæmoptysis, but often he is apparently in good health when he is suddenly attacked with profuse hæmoptysis, the blood being florid, the hæmorrhage sometimes lasting many days, and always causing a reduction in flesh and strength. Cough and expectoration follow, yet examination of the chest only indicates slight signs, and sometimes none at all. When present they are to be found in the supra- or inter-scapular regions, or below the clavicle. The patient improves, and often entirely loses his cough before the recurrence of the hæmorrhage, which may not take place for days, weeks, months, or even years. If the attacks recur often, the cough becomes persistent; the expectoration, when not sanguinolent, is muco-purulent; wasting and night-sweats appear; and the physical signs now show unmistakable consolidation, which goes on to softening and excavation. In most cases the disease does not extend beyond consolidation, and large quantities of blood are expectorated without fatal results, the patients recovering in the intervals, and sometimes living to a considerable age. Peacock says that in most instances some more or less exciting cause is to be detected, in the form of syphilis, cold, dysentery, bodily strain, exertion of voice; but the writer has often failed to find one. The pathology of this form of phthisis is uncertain, because few of the patients die in the early stage; but it is probable that the hæmorrhage is produced by tubercular formations in the neighbourhood of, and implicating the walls of, some of the larger vessels at the root of the lungs. Though this can be considered only a clinical variety of pulmonary phthisis, the cases are genuine instances of consumption, as is proved by the fact that, if they live long enough, they run the same course of increasing consolidation and excavation as ordinary phthisis.

8. **Laryngeal Phthisis.** *See* LARYNX, Diseases of.

9. **Chronic Tubercular Phthisis.**—This constitutes the ordinary type as sketched under the head of symptoms. In the autopsies of this form are to be found all the pathological elements of phthisis, namely, tubercle—miliary, grey, and white—caseous masses, and infiltration—grey and catarrhal—croupous pneumonia, fibroid tissue, and calcareous deposits,—showing that no abrupt pathological line of demarcation can be drawn between the different varieties of phthisis, whatever clinical peculiarities they may present; and that the appearance of miliary tubercle is a matter of infection of the lymphatics, in which time plays an important part.

DIAGNOSIS.—Phthisis is distinguished from other chest-affections principally on the evidence of physical signs. The evidences of consolidation separate it at once from bronchitis; while the tendency of the signs to become localised in the apices of the lungs, their special characters, and the combination of consumptive symptoms, distinguish it generally from pneumonia.

Of the various forms of phthisis, the most difficult to diagnose from other diseases is acute miliary tuberculosis, which at its onset is sometimes mistaken for acute bronchitis, from the fine *râles* and rhonchi accompanying the miliary formation. It has also been confounded with enteric fever, from the high pyrexia, the depression of the patient, and the occasional diarrhœa accompanying it; but in both cases the rapidly advancing symptoms, and the steadily progressing physical signs, such as increased and scattered crepitation, if proper and frequent examinations be made, ought to leave us in no doubt as to the nature of the case.

The diagnosis between scrofulous pneumonia (acute phthisis) and croupous pneumonia is not easy at the ushering in of these complaints, the physical signs not always sufficing for this purpose. In a short time, however, the detection of lung-tissue in the sputum, and the rapid wasting, make matters quite certain.

The diagnosis of chronic tubercular phthisis from anæmia and chlorosis, sometimes confused with it on account of the amenorrhœa often common to both, is made by the physical signs; by the different kinds of pallor in the two diseases; and lastly, in chlorosis, by the absence of wasting. The diagnosis of excavation in phthisis from bronchiectasis is by no means easy, as the position of the cavernous sounds is not always sufficient to determine the nature of the lesion. Dilated bronchi are found in the subclavicular and interscapular regions, and where ulceration is proceeding in bronchiectasis lung-tissue may be detected in the sputum. The convulsive character of the cough, and the fœtid expectoration, abundant, but mixed largely with air, generally enable us to decide in favour of dilated bronchi.

DURATION AND PROGNOSIS.—Early detection of the disease, and improved treatment have worked a great revolution in our ideas as to the *duration* of phthisis.

The estimates of Laennec, Louis, Bayle, and others assigned two years as the mean duration of life in phthisis generally. Pollock's statistics, founded on between 3,000 and 4,000 hospital cases, give a considerable extension of this, inasmuch as at the end of two years and a half the majority were sufficiently recovered to have a fair expectation of life.

The statistics of C. J. B. Williams and the writer, founded on 1,000 cases among the upper classes, give an average duration in 198 deaths of 7 years 8·72 months; and in 802 living of 8 years 2 months. The fact of these patients having all been one year and upwards under observation necessarily excludes some of the acute cases; but with this limitation these figures, striking though they be, may be taken as a correct average for the duration of the disease among the upper classes under modern treatment, especially as 72 per cent. of the living had recovered sufficiently to pursue their usual avocations, and many among them had already lived upwards of twenty years since their first attack. The duration of the disease is found to be considerably influenced by age; for it is longer in proportion as the age of attack is later, this retarding influence being more conspicuous among males than females. Females are attacked earlier, and the disease in them runs a shorter course by nearly two years than among males.

Of the varieties of phthisis acute tuberculosis is the most rapid in its course, generally termi-

nating in a few weeks, or occasionally in a few days. Scrofulous pneumonia has hardly a less rapid course, though it may occasionally be retarded, the disease becoming chronic, and the patient surviving for many years. Laryngeal phthisis has a short duration, and most unfavourable prognosis. Catarrhal phthisis has an average duration somewhat below the average of eight years of ordinary phthisis. Fibroid phthisis, on the other hand, exceeds the ordinary duration by nearly two years. Hæmorrhagic and scrofulous phthisis are both of long duration. These calculations are based on statistics of patients of the upper classes treated according to the best medical and hygienic treatment known; but if hospital cases are reckoned, the average of duration of phthisis generally, and of its various forms, must be held to be much lower than the above estimate.

The prognosis in phthisis depends chiefly on the extent to which the system is infected, and especially whether or not other organs are the seats of tubercle. Cases of acute tuberculosis resemble closely those of pyæmia in their symptoms and fatal course, and only differ in the nature of the pathological products. Similarly single-cavity cases, where the disease is strictly limited, bear a strong resemblance to chronic abscesses, which go on discharging for long periods, without materially curtailing the life of the patient. The future, therefore, of the patient depends to a great extent on whether the disease may be considered local or general, though of course we admit in both instances a constitutional predisposition, possibly of different degrees of intensity. Where the infection is rapid and complete, as in acute tuberculosis and most instances of scrofulous pneumonia, the prognosis is most unfavourable. Where, again, the disease is limited to one lung, and associated with similar processes in the joints, as in scrofulous phthisis, which act as diverticula to the central disease, the prognosis becomes far more hopeful, and the individual may last on for many years.

The prognosis in laryngeal phthisis is most unfavourable, on account of these cases being always associated with extensive lung-tuberculosis; while in hæmorrhagic phthisis, where the pulmonary mischief is small and limited to the root of the lungs, it is favourable, excepting of course the accident of death during an attack of hæmorrhage. The most favourable prognosis of phthisis must be retained for cases of inflammatory origin, for here the disease often remains limited for considerable periods of time, and the patient may live on, almost unconscious of it, to the natural term of life. If, however, the fibroid element be largely produced, a new danger arises from the obstruction to the circulation, caused by the contraction of the lungs, dropsy, dilatation of the heart, affection of the kidneys, and death.

The influence of *heredity* on prognosis lies in its precipitating the onset of the disease, and not in its curtailing its duration, though, of course, an individual attacked earlier will die at an earlier age, the duration of the disease being the same. The influence of *stage* must be duly taken into account, for statistics show a far more favourable prospect for mere consolidation than when a cavity is formed, and this is obvious from the increase of danger arising from two sources, namely from purulent infection and pulmonary aneurisms.

The grounds for an unfavourable prognosis are:—1, rapid extension of disease or of lung-excavation; 2, persistent afternoon pyrexia; 3, symptoms of great irritability of the gastro-intestinal tract, red tongue, diarrhœa, pain in the abdomen; 4, great wasting with, or without, pyrexia, combined with a good appetite; and 5, strong hereditary predisposition, showing itself in several brothers and sisters being attacked at an early age.

Treatment.—The treatment of phthisis may be considered under three heads—1. *medicinal*; 2. *dietetic* and *hygienic*; and 3. *climatic*.

1. *Medicine.*—The medicinal treatment must be directed to three objects: firstly, to raise the standard of nutrition and to counteract the phthisical cachexia; secondly, to reduce and allay the local inflammations and congestions which accompany, and considerably complicate, the tubercular changes; and thirdly, to relieve the various urgent symptoms. The *first* object is carried out by tonics, such as iron, quinine, arsenic, the mineral acids, and, above all, cod-liver oil, which has been shown to be the most effective agent of all in counteracting phthisical disease. Some precautions are, however, necessary to ensure its being tolerated for long periods. The pale oil should be preferred, and ordered in doses of from ʒj to ʒss shortly before or after meals. The best vehicles for it are the vegetable bitters—such as gentian, calumba, quassia, nux vomica and strychnia, hop, camomile, and cascarilla—combined with an acid or alkali, according to the state of the gastric mucous membrane, and rendered more palatable by the addition of tincture or infusion of orange peel or syrup of ginger. Various other vehicles are used, such as milk, salt and water, lemon-juice, orange wine, and sherry; while many patients, especially children, take it best in an emulsion, composed of cod-liver oil, a few drops of strong liquor potassæ or liquor ammoniæ, with an essential oil, like that of cloves or cinnamon, to cover the taste. In the great majority of cases cod-liver oil is well borne, if exhibited with discretion. Other oils are of use, but few equal the cod-liver oil in efficacy, on account of its great penetrative power, and of its forming with the biliary and pancreatic juices a compound easily absorbed by the lacteals. Malt extract and similar preparations, though of greatly inferior nutritive power to cod-liver oil, often cause increase of weight, chiefly by assisting the patient to digest more starch. Of greatly inferior utility to the oil are the preparations of phosphorus and sulphur, such as the hypophosphites of lime, soda, and iron, sulphurous acid, and the sulphites, all of which have a considerable amount of testimony cited in their favour as tonics and blood-purifiers.

In France the sulphur springs of Eaux Bonnes, Cauterets, Bagnères de Luchon, and Bagnères de Bigorre are largely frequented by consumptives, the ground of this treatment being that the results of Claude Bernard's experiments show that sulphur when absorbed is excreted through the

respiratory mucous membrane. Peter considers that any benefit that may accrue is owing to the influence of sulphurous acid on the catarrhal conditions. The arsenical waters of La Bourboule and Royât are strongly recommended by Dr. Noel Gueneau de Mussy.

We may here consider the treatment of the pyrexia of phthisis. In addition to rest in bed, anti-periodics, as quinine in large doses in an effervescing saline, salicine (gr. x), and salicylate of soda (gr. x to xx), may be given every four or six hours, if the pyrexia be considerable. If the temperature only slightly exceed 100° F., and if it be followed by much sweating, then arsenic, in the form of liquor arsenicalis or liquor arsenici hydrochloricus (♏ii to v), three times a day, is indicated. Where these medicines fail, recourse may be had to cold compresses over the chest, to sponging with vinegar and water, and if the patient's strength permit, to the 'wet pack,' swathing the patient in wet sheets; and if the pyrexia be very persistent and tormenting to the sufferer, immersion in a bath of 90° F., lowered gradually to 60° F., may be tried. The reduction of temperature and consequent relief is great, but not always permanent in character, and pyrexia in phthisis may be considered one of its obstinate symptoms.

The *second* object of treatment, the reduction of local inflammation, is best accomplished by mild antiphlogistic means, such as salines, with or without antimony; and counter-irritation to the chest-wall by blisters, iodine, or vesicating liniments, mustard, or the milder but still effectual application of linseed-meal poultices. Steady continuance with these will often render sedatives for the cough unnecessary.

The *third* object, namely, the palliative treatment, includes that of the various urgent symptoms.

The *cough*, when not reduced by the counter-irritation, may be to a certain extent allayed by a combination of sedatives, such as opium and its salts, conium, henbane, hydrocyanic acid, American cherry, with mild expectorants, of which chloric ether, lemon juice, and squills are examples. Where the cough is frequent and the expectoration difficult, and there is proof of active disease, tubercular or pneumonic, proceeding in the lungs, an effervescing saline, containing carbonate of ammonia, with small doses of opium and antimonial wine, taken two or three times at night, will greatly relieve the symptoms, the rule in the treatment of consumption being to restrict the sedatives, as far as possible, to the night, so as not to interfere with the appetite and digestion. The preparations of tar, in the form of capsule, pill, or solution, are useful in reducing profuse expectoration. The inhalations of iodine, compound tincture of benzoin, carbolic acid, creasote, larch and turpentine, are useful if expectoration is offensive or requires stimulating; or again, those of chloroform, conium, hop, when the cough is convulsive and dry.

The *pains* in the chest may be alleviated by painting with tincture of iodine or stimulating liniments, such as turpentine and ammonia; or else on Dr. Roberts's plan, by securing the immobility of the side by strapping.

*Night-sweats*, when profuse, may be reduced by oxide of zinc (gr. ij to iv), by gallic or sulphuric acids, by sulphate of iron, by arseniate of iron (gr. $\frac{1}{6}$ to $\frac{1}{3}$), but most effectually of all by the preparations of belladonna, in the form of the extract (gr. $\frac{1}{4}$ to gr. 1), or as solution of sulphate of atropia (♏j to ij), or used hypodermically. Dover's powder in 10-gr. doses is useful, but Dr. Murrell has lately strongly recommended picrotoxine (gr. $\frac{1}{60}$, in form of a pill), or muscarine (♏v of one per cent. solution), to be taken at bed-time, as more effectual.

*Diarrhœa*, where due to bilious derangement and an acid state of the primæ viæ, is best treated by mercurial purgatives, combined with carbonate of soda or lime-water. Where it partakes of the nature of a flux, accompanied by a pale tongue and great debility, it may be checked by astringents, such as hæmatoxylon, catechu, krameria, bael, and carbonate or citrate of bismuth. When ulceration of the intestine is proceeding, it is characterised by a red, irritable tongue, pain and tenderness of the abdomen, and persistency of the diarrhœa. Here, as in other forms of ulceration, opium and its salts answer best, and may be given internally with sulphate of copper (grain $\frac{1}{4}$ to $\frac{1}{2}$) every three or four hours. When the stomach is too irritable to tolerate medicine by the mouth, opium and morphia suppositories are useful, but still better are opiate enemata, which, acting directly on the irritable ulcers, check the pain and diarrhœa, and often afford considerable relief. In very obstinate cases tannic acid (four to five grains), acetate of lead (three to four grains), may be added to the injection. The opposite state of bowels, namely, constipation, is very common in the early stages of phthisis, and is best corrected by changes in diet, such as the use of brown bread and oatmeal, cooked and fresh fruit, regular exercise, and if these prove insufficient, a mild aloetic or rhubarb pill, or the use of some mineral water, as Friedrichshall, Pullna, Carlsbad, Hunyadi Jànos, and others.

The *dyspnœa* of advanced cases generally arises from difficulty of expectoration, and the greatly curtailed respiratory power, and may be relieved by spiritus ætheris, carbonate of ammonia, and other diffusible stimulants. The pain arising from perforation in pneumothorax is best treated by opium, and strapping the side to limit the movements of respiration, and if much liquid effusion or accumulation of air takes place, it is sometimes advisable to tap the chest; but, as a rule, the state of the patient does not allow of very active measures.

*Bed-sores* should be prevented by the use of a water-bed, and the skin of the dependent parts can be fortified by lotions of spirit and water (one part in four). If a bed-sore has formed, it is best to protect it from friction by the use of circular air or down cushions, or thick felt-plaister, and the raw surface can be painted with collodion, or be regularly dressed.

2. *Diet.*—The great object being to introduce as large a quantity of nutritious food as can be digested, abundance of meat, plainly cooked, with fresh vegetables, and a fair amount of bread and starchy food should be given. Fatty material, if it can be digested, should be largely represented in the dietary, and many physicians

advise large quantities of cream, butter, and suet; but, considering the large amount of fatty matter included in cod-liver oil, which is a severe test at first to the digestive powers, it is not advisable to increase the amount of fat until the oil is well tolerated. Milk (1 to 1½ pints a day), alone or with lime-water, is a staple food for the consumptive; and when cow's milk disagrees, ass's or goat's may often be substituted with advantage. Koumiss and whey are frequently used in Germany and Russia, but they have not become popular in this country. The digestive powers being, as a rule, weakened, much good may be done by the addition of animal ferments, such as liquor pepticus and liquor pancreaticus (Benger) to the food, which, becoming peptonised, is much more easily assimilated (*see* PEPTONISED FOOD). In the early stages stimulants are not largely required, as they increase the cough and lung-irritation; but when the strength fails, and the powers of digestion are weak, they may be given frequently, and advantageously combined with liquid nourishment, such as eggs, soups, various meat-essences and panadas, arrowroot, and jelly. When wine is required, in chronic cases, it will be found that claret, hock, sauterne, and chablis tend to irritate the cough less than the stronger wines.

*Hygiene.*—The consumptive patient should inhabit a well-ventilated, well-drained house, built on a dry soil, sand or gravel, sheltered from cold winds and well exposed to the south, not hemmed in by trees, the most suitable for the neighbourhood of the house being of the coniferæ order. The bed-room should be lofty, provided with a fireplace for warmth and outlet ventilation; and unless the cubic space be abundant, inlets for the supply of fresh air, in the form of vertical tubes, should supplement the ordinary indraught of the door and window.

*Clothing and Exercise.* — The underclothing should be woollen, either flannel or lambswool, or perhaps in summer merino may be allowed, the object being to secure a good non-conductor of changes of the temperature which will, at the same time, absorb cutaneous moisture. The rest of the clothes must be adapted to the season, the invalids, male or female, always bearing in mind their greater liability to catarrh than ordinary persons, and using wraps freely, more especially when driving.

Exercise must depend on the stage of the disease, and the strength of the patient. In the first stage, especially when the disease is limited to one lung, and no fever or hæmorrhage is present, active exercise in the form of walking is advisable. Under careful superintendence certain gymnastic exercises may be of benefit, which, by raising the arms, lift the upper ribs, and increase the size of the thoracic cavity, especially in the upper regions, and thus necessitate a larger inspiration of air, and in time this leads to further development, and even to hypertrophy of the healthy lung. Emphysema may be produced in the diseased lung by this means, which is useful in limiting any further advance of infective tubercular disease.

Riding is excellent for a large number of patients, being intermediate between the active and passive varieties of exercise. Where the disease is more extensive and advanced, only the passive forms of driving and sailing are possible.

3. *Climate.*—The main point to be held in view is to give the consumptive a climate in which he can breathe freely, take abundant outdoor exercise, and experience that amount of stimulating influence which, while it improves his appetite and powers of digestion, does not irritate the mucous membrane of the lungs or increase the cough. The selection is generally difficult, and depends not only on the class of cases, but must be sometimes modified by individual peculiarities. *See* CLIMATE, Treatment of Disease by.

The writer's statistics, founded on 251 consumptives, who passed one or more winters out of England, assign the most favourable results to sea-voyages, and the next to Egypt and other dry climates. The Mediterranean basin follows next in point of success; while the moist temperate climates of Pau and Rome give far less good results, and Madeira only slightly surpasses these. The same statistics show the foreign health-stations to be on the whole more successful in prolonging life than the English ones; but we must not forget that the most advanced cases fall to the lot of the latter, on account of the difficulty of travelling; and, on the other hand, a great advantage enjoyed by the home stations is the superiority of the food and appliances for invalids, which may in some degree compensate for the smaller number of days in which exercise can be taken, and the greater vicissitudes of weather. Of the British health-resorts the dryer ones, such as Hastings, Ventnor, and Bournemouth, have afforded more favourable results than Torquay and Penzance. It is impossible in a few sentences to lay down rules for climate-selection, but a few general outlines may be given of the suitability of different groups of agencies.

The British south-coast stations are beneficial in scrofulous phthisis, and in many cases where the appetite is poor, and tendency to catarrh not the prevailing feature. In the catarrhal form of phthisis Madeira, and the West India Islands, especially the Blue Hills of Jamaica, are advisable; the combination of warmth with saline influence, and the absence of stimulating qualities, seeming to answer best.

*Dry stimulating marine climates*, such as the Riviera, Malaga, and Algiers, are recommended in phthisis of inflammatory origin, and in all cases where it is desirable to combine stimulating influence with a moderate degree of warmth, and decided dryness of atmosphere.

Where the stimulating influence is undesirable, as in patients of excitable temperament, or irritable gastric mucous membrane, the *very dry inland climates*, like those of Egypt or South Africa, are preferred.

*Sea-voyages* to Australia and New Zealand, or the shorter one to the Cape, are indicated in cases of hæmorrhagic phthisis, in cases of limited first or third stage, where the patient's strength is unequal to much exercise, and where he or she have suffered from close confinement in crowded cities.

*High altitudes.*—The increasing mass of testimony in favour of this form of climate-treatment for consumption, in both Europe and America,

augurs that in a few years it will be used more largely.

At present the Andes, the Rocky Mountains, and the Alps, and even the South African highlands, are frequented by consumptives; but the conditions of temperature and altitude manifestly vary greatly; and while the climates of Quito and Santa Fè di Bogota resemble in temperature that of Malaga, the winter extremes of Davos in the Alps are more nearly akin to those of Canada. In all these places, however, there exists a distinctly specific influence apart from that of heat and moisture, in the form of diminished barometric pressure, which is shown in the patients residing at high altitudes. The chest becomes expanded, and hypertrophy of the healthy lung-tissue takes place, accompanied by vesicular emphysema around the lesions. Patients in the first or third stage of phthisis with only limited lesions, endowed with fair powers of circulation and able to take exercise, are the proper cases for this form of climate, and in many of such complete arrest of the disease may be confidently predicted.

C. Theodore Williams.

**PHYSICAL EXAMINATION.**—The object of a physical examination is to ascertain the precise seat, limits, and characters of those evidences of disease which are recognisable by our senses, and which are called physical signs. In making such an examination we bring to bear all our senses, with whatever instrumental aids may be available to detect the signs of disease. In the present article a description will be given of the physical examination of—(1) the patient generally; (2) the cerebro-spinal system; (3) the respiratory system; (4) the organs of circulation; (5) the mediastinum; and (6) the abdomen.

**1. General Survey.**—Our attention will first of all be naturally attracted to the *physiognomy* of the patient, that is to his general appearance and build. We note his apparent *height* and *weight*, and, if possible, correct our observation by scale and measure. We observe the *state of nutrition*, firmness or laxness of muscle, corpulence, thinness, emaciation—atrophy of any particular muscle or group of muscles. The *complexion* of the patient is to be remarked, whether clear, sallow, dark, fair, jaundiced, or pigmented; also lividity or pallor of surface and mucous membranes. The *apparent age* as contrasted with actual years of the patient; elasticity of features, condition of hair, presence of arcus, &c. The *symmetry* and *play of features*, the expression whether of vivacity, despondency, suffering, anxiety, paralysis, or hysteria. *See* Physiognomy.

Whilst making these preliminary observations, a general outline of the history of the patient and of his present illness will have been elicited.

The *pulse* should next be noted (*see* Pulse). We may, in important cases, extend our inquiries or record our observations by means of the sphygmograph. *See* Sphygmograph.

The *respiration* of the patient requires attention as regards rapidity; mechanism, that is, whether abdominal or thoracic in normal proportion; rhythm, regular or irregular, easy or laboured; and freedom or otherwise from pain.



The action of the nares, and any recession or otherwise of soft parts during respiration, should be especially observed. *See* Spirometer.

In health and under physiological conditions of age, exercise, emotion, &c., there is a tolerably constant ratio between the respiration and pulse-rate, namely, one respiration to from three to four pulse-beats. In disease this ratio is often much altered. The average respiration-rate in a healthy adult is from 17 to 20 per minute, in the infant about 40 per minute, between one and five years about 26 per minute. In old age the respirations are very slightly accelerated: in children they are quick and often irregular, being momentarily suspended by anything that excites their wonder or close attention.

The *odour of the breath* may attract attention. It may under morbid conditions be fœtid, urinous, 'mercurial,' alcoholic, or gangrenous. *See* Breath, The.

The condition of the *skin*, whether dry or hot, moist or sweating, and the presence or absence of any eruption, scars, ulcers, or pigmentation, will be duly noted. The presence of *pyrexia* will be exactly ascertained by the use of the clinical thermometer, an instrument which ranks with the stethoscope in value; but the employment of the thermometer does not exclude the necessity of testing the condition of the surface by the hand, whereby we observe the resultant, so to speak, of the bodily heat, tempered it may be by evaporation, or exaggerated by undue dryness in exposed parts. Probably the use of the surface thermometer, in combination with the ordinary clinical instrument, would more exactly give us this information, upon which important therapeutical indications rest; but the hand of the skilled observer fully suffices for the purpose. The surface thermometer is of value in estimating localised elevations of temperature; for example, over the site of an empyema, in peritonitis, and in connection with certain nerve-lesions. *See* Thermometer.

The condition of the *finger-ends*—clubbing, lividity—must be observed. Important information as to previous acute illnesses within the past six months can be obtained by inspecting the nails, a transverse furrow marking the period of defective or arrested nutrition during such illness.

The condition of the *teeth* may indicate previous illness or syphilitic inheritance.

The state of the *eyes*, and especially any irregularity of the *pupils*, requires attention.

The condition of the *tongue* and *gums* furnishes us with valuable information.

The careful superficial inspection of the patient in the manner above sketched will perhaps at once lead to a more minute examination of some one organ or system of organs as the probable seat of disease; and having thus far succeeded in locating the disease, the other organs and functions of the body will of course come under review, but the physician will be more especially inquisitive with regard to such organs or functions as may be in sympathy with those in which disease has been detected.

It may be, however, that on careful examination we fail to find any organic lesion to account for the symptoms present, and for signs of wasting,

pyrexia, &c., which notify the illness of the patient. We may then—but not till then—refer the case to one of those blood-conditions which for a time run their course without manifesting any definite lesion.

Again, it may be that certain signs of general illness, and especially pyrexia and wasting, cannot be accounted for sufficiently by the amount of disease discovered. Here we must suspect that the lesion we have ascertained is but an expression of a more general state.

Having made these remarks—relating to orderly measures of inquiry, without a due regard to which no physician or surgeon, however skilful in any one department, can fail to commit the errors of the narrowest specialist—we will proceed to consider the physical examination of those regions of the body, especially the chest and abdomen, in which objective signs can be accurately observed.

2. **Cerebro-spinal System, Physical Examination of.**—The objective phenomena of disease affecting the nervous system are often very obscure, and it is the more important that they should be sought for in a methodical manner.

(*a*) The Head.—The head should be examined as to size, shape, condition of fontanelles, the presence of wounds, tumours, or depressions.

The *size* of the head varies greatly in different people, without any seemingly corresponding variation in the condition of the brain. It is very difficult to say whether enlargement of head is due to thickening of the skull or enlargement of its contents. In rickets and in hydrocephalus the head is relatively large; in idiocy relatively small.

The *shape* of the head is of more importance than the size. We may recall the long head, with square, high forehead, of rickets; the broad, vaulted skull, with shallow orbits and prominent eyes, of hydrocephalus.

*The condition of the anterior fontanelle* must be carefully observed in all cases of children with cerebral symptoms—it should be neither tense nor depressed.

The detection of *local changes*, such as thickenings, tumours, scars, or depressions over the skull, will throw much light upon a case presenting cerebral symptoms.

(*b*) The Spinal Column.—The spinal column must be carefully examined for undue prominence or depression of spinous processes, or other tumours, and for lateral or antero-posterior curvature. Kneading and percussion should be employed over each spinous process to elicit any tenderness. The fingers should be passed firmly along the spinal groove on either side to ascertain if there be any painful point, and much care must be taken not to confound such pain (commonly neuralgic) with true spinal tenderness. The application of the hot sponge, or ice-bag, successively to different parts of the spine is a means of eliciting valuable signs of disease.

In all cases of suspected spinal or cerebral disease the *superficial* and *deep reflex actions* should be tested, as affording important indications respecting the integrity of successive portions of the cord, and the condition of the parts above. *See* Spinal Cord, Diseases of.

By the *ophthalmoscope* an example of the cerebral circulation may be observed in the retina, and the condition of vessels noted. Certain lesions of the optic disc correspond also with deeper and more widespread nervous disease (*see* Ophthalmoscope in Medicine). By the use of *graduated compasses* the sensibility of the peripheral nerves may be estimated. *Electricity* enables us to ascertain the irritability of voluntary muscles; and by the *dynamometer* we may compare muscular power on the two sides. *See* Electricity; and Dynamometer.

Further details respecting the diseases of the nervous system, and the methods for their diagnosis, will be found under appropriate headings.

3. **Respiratory System, Physical Examination of.**—The respiratory system includes the respiratory tract and lungs.

(*a*) Larynx.—The condition of the larynx and trachea is examined into by listening to the voice, whether husky, altered in tone, or suppressed. Any tenderness or external deformity is ascertained by careful palpation.

By means of the laryngoscope the condition of the epiglottis, larynx, and trachea can be thoroughly explored. *See* Laryngoscope; and Larynx, Diseases of.

(*b*) Chest.—In making an examination of the chest, the physician should follow a methodical routine of **inspection, palpation, percussion,** and **auscultation.**

1. **Inspection.**—The *general shape* and *build* of the chest is observed — whether it be the broad, well-formed chest of robust health; or the small, narrow, long chest, with antero-posterior and lateral diameters diminished, costal angle narrow, and ribs oblique and approximated—adapted to small lungs. Or the thorax may be unduly expanded, with wide intercostal spaces, straightened ribs, widened costal angle, and deep antero-posterior diameter, to accommodate large lungs. Again, the thorax may be distorted by various kinds of spinal curvature, or as the result of rickets, or from external pressure, as in the depressed lower sternum of shoemakers (*see* Deformities of the Chest). Lastly, there may be *local* flattenings or bulgings.

The *movements* of the chest are of great importance in diagnosis. We estimate the freedom or otherwise with which air enters the chest during inspiration by the equable expansion of its several parts, or by the immobility or recession of any portion the entry of air into which is retarded or impeded; and this can be accurately done by means of the pneumograph. In cases of general obstruction to entry of air, whether by impediment at the main air-passage or in its entire distribution, there is universal recession of all the soft parts—the supra-clavicular region sinks downwards, the hypochondria recede, and the intercostal spaces deepen during the effort to expand the chest against atmospheric pressure. On the other hand, when the difficulty of expansion, whether from intrinsic disease or obstruction of passages, is restricted to one side of the chest or to a portion of one lung, the restrained expansion during inspiration is limited to that portion. Thus from inspection alone we may often form a shrewd guess

as to the seat and even the nature of the disease present.

In estimating local alteration of shape the eye is perhaps more useful than any instrument of measure. *Calipers* of various patterns may be used for taking diameters in different directions. But for *recording* differences of shape on the two sides the *cyrtometer* is very useful. This instrument was originally introduced by M. Woillez, and consisted of two halves of a jointed whalebone measure, connected by a hinge, which could be adapted accurately to the shape of the chest, and after removal the various curves on the two sides could be traced on paper. The cyrtometers now most in use are made of soft metal, two sufficiently long pieces of which are connected by an indiarubber joint or hinge.

Double tape-measures are also used for ascertaining the circumference on the two sides, and by their means the relative expansion during respiration on the two sides can be compared. Various forms of stethometer have been designed for the same purpose. *See* STETHOMETER.

The *vital capacity* of the lungs may be very accurately estimated by means of the spirometer. *See* SPIROMETER.

2. **Palpation.**—Palpation is employed in aid of both inspection and percussion.

*a.* During preliminary inspection of the chest the *position of the heart's apex-beat* should be invariably, and as a matter of habit, ascertained, and any deviation from its normal seat, namely, the fifth intercostal space one inch to the sternal side of the left nipple line, should be noted.

*b.* Any local bulging or tumour will naturally be *manipulated* to ascertain its relation with bone, or soft structure, whether it be solid or soft, fluctuating or pulsatile.

*c.* In connection with percussion, the trained observer will note differences of *resistance*, as well as of sound, over diseased areas.

*d.* Increase or diminution of *vocal vibration* or *fremitus* will be noted over any spot of altered resonance, by applying the hand and making the patient utter some resonant words, such as 'ninety-nine.'

Vocal fremitus is *increased* by consolidation of lung; *diminished* by much thickening of the pleura, by obstruction to the main bronchus, or by air in the pleura; *annulled* by fluid in the pleura. N.B.—In many cases of fluid in the pleura some vibrations are felt, probably communicated from above. The loudness or feebleness of the voice must of course be taken into account in estimating fremitus, and corresponding parts on the two sides should always be compared.

Loud, coarse, bronchial *râles* may cause the chest-walls perceptibly to vibrate, producing *rhonchal fremitus*. Pleuritic friction may likewise be perceptible to the hand applied—*friction fremitus*. In cases of effusion into the pleural cavity, or in hydatid cysts near the surface, *fluctuation* may be elicited on palpation.

3. **Percussion.**—Percussion is the method of examination by which we detect the various degrees of resonance of different parts of the chest, depending upon the relative amount of air and solid structure.

It is best to use the fingers for percussing, one finger of the left hand being placed firmly over the point to be percussed, and struck with one or two of the fingers of the right hand, semi-flexed, so that the tips of the fingers fall vertically upon the pleximeter finger. Percussion should be made from the wrist, not from the elbow; the stroke should, as a rule, be light, and always perfectly even on the two sides; sometimes a heavier stroke may be needed, but, as a rule, far more information is obtained from light than from heavy percussion. In comparing the percussion note over the two sides of the chest, points exactly corresponding must be taken, and the pleximeter finger must be placed in a corresponding position; for example, it must not be placed parallel with the ribs on one side and across them on the other.

The sense of touch is very valuable in percussion in estimating *resistance* of the part struck. Dulness, and particularly the hardness and want of resilience over thickened adherent pleura, may thus be readily *felt* by the pleximeter finger during percussion. This sense of touch should be carefully cultivated, and its deprivation is a great disadvantage in the use of the artificial pleximeters and percussors first introduced by Piorry, although possibly these may be useful for demonstration to a class. The observer should not be content with comparing corresponding points on the two sides of the chest from above downwards, but he should invariably trace any dulness or resonance from either side across the sternum to ascertain the limits of resonance or dulness in this direction. From neglect of this, important information is often missed. The height to which the pulmonary note extends above the clavicle on the two sides should be compared.

*Regions of the Chest.*—For convenience in describing the distribution of signs, both of percussion and auscultation, it is customary to divide the chest into regions. The names employed to distinguish these regions sufficiently define their limits, namely, the supra-clavicular, clavicular, infra- or sub-clavicular, mammary, infra-mammary regions on each side in front; the superior and inferior axillary regions; the supra-spinatus, infra-spinatus, interscapular, and infra-scapular regions on each side posteriorly.

(*a*) NORMAL PERCUSSION SIGNS.—There is a certain standard degree of resonance over the lungs, only to be duly estimated by experience, which is known as *normal pulmonary resonance*. In certain regions of the chest the pulmonary resonance is naturally lessened or replaced by dulness. Pulmonary resonance should commence $1\frac{1}{2}$ inch above the level of the clavicle. In the clavicular and sub-clavicular regions, on firm percussion, the note should be even on the two sides, as low as the third rib. Below this level on the *right* side, we still obtain full resonance until we arrive at the fourth space, where in the mammary line the note becomes slightly raised and shortened, becoming dull in the fifth space and downwards to the margin of the cartilages. On very light percussion the pulmonary resonance may be obtained half a space lower, and at least an inch to two inches' difference in level may be obtained between the extreme limits of deep expiration and inspiration. In the lateral (axillary) region the limit of percussion-resonance

reaches about an interspace lower. At the sternal margin it is a little higher, from the encroachment of the right side of the heart upon the inferior angle of the lung. Roughly, and for clinical purposes, a line drawn outwards from the base of the xiphoid cartilage may be said to define the upper border of the liver-dulness.

On the *left* side, in the line midway between the sternum and nipple, we already, at the third cartilage, obtain elevation of pitch and shortening of the percussion note; and at the fourth space dulness, from the underlying heart. Between this (mid-sterno-nipple) line and the sternum, and bounded above by the fourth cartilage and below by the level of the apex-beat, is the normal area of superficial cardiac dulness. In the nipple line at the corresponding levels[1] some deadening of percussion note may be obtained, but pulmonary resonance is otherwise clear to the sixth rib; in the lateral axillary region to the seventh. Below the sixth rib in front, and the seventh laterally, stomach resonance is obtained.

Over the *sternum*, percussion is naturally somewhat wooden and resisting, within degrees varying with the condition of the bones. The first piece of the sternum is normally somewhat less resonant than the next two pieces, but it should be, on firm percussion, by no means dull. Below the level of the fourth cartilages the heart and liver cause the note to be dull, although even here a certain degree of resonance is in health communicated from the adjacent right lung.

In the *posterior* regions of the chest the degrees of resonance are almost entirely in accordance with the thickness and character of superjacent tissues. Thus in the scapular and inter-scapular regions increased force of percussion is necessary to elicit pulmonary resonance, whilst in the lateral and infra-scapular region the percussion note is full and low-pitched. On the right side this resonance is replaced by dulness below the tenth rib, and deep percussion will elicit a certain impairment of resonance as high as the ninth rib, in the mid-scapular line. On the left side resonance should be good to the extreme base, except that in the posterior axillary line a small and restricted area of dulness may be sometimes made out, corresponding with the position of the spleen.

(*b*) Morbid Percussion Signs.—Modifications in the distribution of percussion-resonance over the chest may be produced either by general or by local causes.

*General causes.*—Pulmonary vesicular emphysema, by enlarging the lungs and extending their boundaries, causes encroachment of pulmonary resonance over those regions—the præcordial, right infra-mammary, sternal, and right inferior basic, which are normally dull. In congenital smallness of lungs the boundaries of pulmonary resonance are somewhat retracted, so that liver-dulness in front and behind is slightly higher, and heart-dulness more extensive.

*Local causes.*—One class of these are encroachments of other organs. Enlargement of the heart will cause increased area of præcordial dulness upwards and to the left, or upwards and to the right, according as the left or right side of the heart is most affected. Effusion into the pericardium will cause similar dulness, extending upwards towards the manubrium sterni, and to the right beyond the sternum. Aneurismal tumours in connection with the heart or great vessels, give rise to dulness, chiefly in the neighbourhood of the sternum above the fourth cartilage, or in one or other inter-scapular region. Enlargement of the liver and spleen will cause them to encroach upon the pulmonary resonance. Effusion into the peritoneum, if extensive, will cause displacement upwards of the abdominal organs and diaphragm, encroaching upon the lower area of pulmonary resonance, and even causing collapse of the lower portion of the lungs, thus giving rise to dulness.

Effusion of fluid into the pleura will give rise to absolute dulness to the level to which the effusion extends upwards. The upper boundary of this dulness, if the lungs be sound, varies slightly with the position of the patient. In order, however, accurately to define the upper margin of dulness from fluid effusion the lightest possible percussion must be employed. In any case of considerable effusion into the pleura the dulness encroaches upon the median line, and towards the opposite side. *See* Pleura, Diseases of.

The chief kinds of morbid percussion signs will now be discussed.

*Dulness, hardness, flatness.*—These terms are by no means synonymous with regard to percussion sounds. *Dulness* varies infinitely in degree. Thus over a pleuritic effusion the tonelessness is absolute; and to this degree of completeness of dulness the term *flatness* of percussion-note is sometimes applied. There are but a few other chest-conditions in which such absolute dulness is obtained; for example, extensive pericardial effusions, hydatid tumours, extensive malignant growths invading the lungs and infiltrating the bronchi. In inflammatory consolidation of the lung there is always a certain degree of wooden tone in the percussion note. In cases of scattered patches, or nodules, of consolidation in the lungs, with air-containing tissue around, the dulness may be only very slight, amounting to a mere shortening of the note with elevation of pitch. In estimating the slight shades of dulness elevation of pitch is the first point to arrest the attention. *Hardness* of percussion, always more or less appreciable with dulness, is associated especially with consolidations of lung overlaid by thickened adherent pleura.

*Skodaic resonance.* — In all cases of considerable effusion of fluid into the pleura, in which the lung is not completely collapsed, a peculiar high-pitched tympanitic resonance is found at the sterno-clavicular region on the same side. This resonance, called Skodaic resonance, is a very characteristic sign, and has been attributed to relaxation of lung still in contact with the chest-wall. As the effusion advances to completely fill the chest, this resonance becomes replaced by dulness.

When effusion of fluid follows upon pneumothorax, the lung, unless held above by strong

[1] By employing the terms 'lines' and 'levels' to mean the vertical lines and horizontal levels, in connection with definite anatomical points, *e.g.* mid-scapular-, nipple-lines, nipple-, second-, third-, fourth-, &c., rib levels, any portion of the chest-surface may be accurately defined.

adhesions, is already completely collapsed; and above the level of the dulness caused by fluid there is a tympanitic note, caused by free air in the pleura. In this case the level of the fluid in the pleura shifts with every change in the position of the patient.

Whether the effusion be of serum, pus, or blood, the percussion signs are the same.

*Wooden percussion-note* is obtained by percussing over thickened pleura with some air-containing tissue beneath. The sense of resistance is marked, the pitch high, and the duration of sound short. This degree of dulness, with increased resistance, is commonly present below the clavicle in cases of phthisis, with thickened pleura, and perhaps small, empty cavities, bounded by hardened lung-tissue.

*Amphoric or tubular percussion* is the sound elicited by percussing over a superficial empty cavity, connected by adhesions to the chest-wall. The pitch varies with the size of the cavity, but is always somewhat high. The sound can be exactly imitated by percussing the cheek drawn tensely over the teeth, with the mouth slightly open.

*Cracked metal sound*, or *bruit de pot fêlé*, is obtained by sharp percussion over a cavity such as the above. Sudden displacement of air in the cavity will cause the sound, which somewhat resembles that produced by placing the two hands hollowed in apposition, and striking upon the knee. A little secretion in the cavity will facilitate the production of the sound. This sound may often be appreciated by the touch before it can be heard. It is of little clinical value.

*Bell-sound* is elicited by combined percussion and auscultation, and *when present* is characteristic of pneumothorax. The stethoscope must be applied over the resonant part of the chest, and at another point within the same area a piece of metal, such as a coin, laid upon the chest, must be smartly struck with a second piece of metal. The auscultator hears a sound of a clear bell-like character within the chest, which is of quite a different quality from that produced by the mere contact of metals. It is essential for the production of this sign that the stethoscope and the struck metal be both within the area of chest-surface corresponding with the air-containing sac of the pleura. If, for instance, either be placed over a point below the level of any fluid effusion present the sound will be lost, to be recovered on altering the position of the patient so as to displace the fluid. By means of this sign, the limits of a pneumothorax may be accurately defined.

*Hydatid fremitus* is a vibratile sensation, sometimes to be felt on smart percussion over an hydatid effusion. In cases of pyo-pneumothorax a similar sensation may sometimes be felt, on percussing at the exact level of the surface of the effused fluid.

4. **Auscultation.**—Auscultation simply means the act of listening; but the art of auscultation implies a great deal more than this, namely, the appreciation of the healthy or morbid conditions which produce the sounds heard on applying the ear to the chest or to other parts. If the ear of the observer be directly applied to the chest or part under observation, auscultation is said to be *immediate*. If some substance or instrument be used as a medium between the ear and the part under observation, *mediate* auscultation is said to be practised. Such an instrument is named a stethoscope. *See* STETHOSCOPE.

(*a*) NORMAL RESPIRATORY SOUNDS.—If the stethoscope be applied over the trachea of a healthy person, tubular blowing, or bronchial respiration, is heard—that is, a sound as of air blown to and fro through a tube, and with moderate velocity; the mechanism of the sound being the entrance and outflow of air-currents through the narrowed glottic aperture of the trachea, producing sonorous vibrations within the tube below. As the stethoscope is passed downwards to the first piece of the sternum, the same sound is still heard, but more distant and muffled. In the upper interscapular region, where the great divisions of the bronchi are comparatively superficial, the tracheal sounds may still be indistinctly recognised; but below and aside from these points these sounds are normally obscured by the vesicular pulmonary sounds, into the production of which they, however, necessarily enter.

The *pulmonary vesicular breath-sound* is produced by the friction of air entering the air-sacs from the minute bronchioles, and it is supplemented by the conduction of what remains of the glottic breath-sound, now infinitely subdivided. During calm breathing the sound accompanying *inspiration* should be soft and breezy, giving the idea of innumerable similar and associated sounds. In intensity the sound is even from commencement to near the end, when it fades without perceptible interval into the expiratory sound. The *expiratory* sound commences at the moment inspiration ceases, being continuous with the inspiratory sound, but it rapidly fades in intensity, ceasing to be audible after the first one-fifth or one-third of the expiratory act. Of the time occupied between the commencement of one inspiration and that of the next, the inspiratory act occupies nearly one-half ($\frac{5}{11}$ths), the expiratory act the remainder, with the exception of a very brief interval of pause, between the end of expiration and the commencement of the next inspiration. It may here be observed that when the expiration is said to be *prolonged*, it is meant that the expiratory sound is audible through a longer period of the act than natural.

If the respiration be hurried and forced, the inspiratory sound is coarser and louder, and the expiration more audible, these sounds approximating to the *puerile* breathing which is normal to young children.

In health the vesicular breath-sound should be about equally well heard over the front and back of the chest, allowance being made for additional thickness of covering over certain regions.

(*b*) MORBID RESPIRATORY SOUNDS.—*Puerile, compensatory*, or *supplementary breathing* is characterised by increased loudness of vesicular breath-sound, with some prolongation of expiration. Besides being audible over the chest generally in healthy young children, this exaggerated breath-sound may be heard over certain parts of the chest in persons who have some other part disabled or diseased. Thus, with effusion of fluid into one pleura, the respiratory

sounds over the opposite lung are exaggerated or puerile. If one apex be diseased, the breath-sound at the other apex is exaggerated. This increased breath-sound to make up for deficient function elsewhere is called *compensatory or supplementary breathing*.

The breath-sound may be *enfeebled* over the whole chest, as in cases of emphysema or thoracic muscular debility. Localised enfeeblement of breath-sound may be due to several causes—(1) local emphysema; (2) adherent and thickened pleura, as after old pleurisy at the base; (3) blocking of the alveoli by catarrhal products—common in commencing phthisis at one apex; (4) closure of bronchial tubes by plugs of mucus, or from spasm. If the rest of the lungs be free, this local enfeeblement is made up for by compensatory breathing on the opposite side, or in other parts of the same lung.

*Suppressed breath-sound* signifies removal of lung from the surface by effusion of air or of fluid into the pleura, or occlusion of a main bronchus by compression or morbid growth.

*Wavy* and *jerking* respiration are terms characterising a kind of respiration, in which the inspiration is either partially or completely interrupted several times. The expiration is rarely thus affected. Waviness of respiration may be due—(1) to an irregular action of the inspiratory muscles, common in nervous people; (2) to cardiac impulse, in which case these interruptions are rhythmic with the heart's pulsation; (3) unequally distributed impairment of the lung-elasticity, for example in early tubercle-deposits. Dr. Walshe considers that pleuritic adhesions may have the same effect. It will be seen then that waviness of breath-sound is very commonly independent of any organic change, and requires other signs to render it of any value in diagnosis. Jerking respiration or interrupted breath-sound is more commonly due to organic lesions of the third kind mentioned.

*Cogged breath-sound* is a somewhat clumsy term applied to a form of interrupted respiration in which the interruptions are very even, three or four to each inspiration. Much importance is attached to the sign by some authors. It appears to be due to obstruction in the smallest bronchioles, either by dryish secretion or small nodules of tubercle, requiring some accumulation of inspiratory force to overcome it. The sounds commonly give place to a bubbling *râle*.

*Harsh respiration with prolongation of expiration* implies a want of vesicularity in the sound. Whilst vesicular breath-sound has been compared to the sound produced by the breeze passing through leaf-laden trees, harsh breathing, on the other hand, resembles a similar breeze traversing their naked branch-tops. Some prolongation of the expiratory sound is inseparable from harshness of breath-sound. Harshness of breath-sound by no means implies increased loudness—rather the contrary. Enfeebled respiratory murmur is commonly harsh—always so when due to alveolar obstruction. The meaning of harshness of breath-sound is simply commencing consolidation; it goes with incipient dulness, and is one of the earliest signs of apex-disease in consumption. There can be little doubt that its real mechanism depends upon the extinction of the vesicular part of the normal breath-sound, and the better conduction of the glottic sounds, which at peripheral parts of the lung are usually muffled and obscured by the vesicular sounds. The prolongation of the expiration is very characteristic of this early alteration of the respiratory sounds; and it may here be observed, in passing, *with regard to morbid breath-sounds, that the expiration is the most important part of the respiratory act to attend to in auscultation.*

*Divided respiration*, usually described as a separate evidence of disease, is really an inseparable factor of harshness of respiration. Instead of the two component sounds, inspiration and expiration, fading imperceptibly into one another, they are more or less distinctly separate, the more so as the more typical bronchial type of breathing is acquired. Deficiency of elasticity is the cause to which the division is usually ascribed; it is, however, a significant feature of glottic breathing.

*Bronchial respiration* is most typically heard over simple lung-consolidation, as pneumonia at the base or apex. Skoda well describes the sound as acoustically identical with that produced by placing the mouth in the position to pronounce the guttural *ch* (as in *ch*oir or *ch*ristian), and drawing the breath to and fro. The inspiratory and expiratory sounds are about equal in length, nearly identical in pitch, and distinctly divided from one another. The sound varies in intensity and definition from the most intense *tubular* or *tracheal* breath-sound, to the lower-pitched and more diffuse *blowing respiration* (*diffused bronchial breathing*). Besides hepatisation of lung, this form of respiratory sound may be produced by other condensations of lung, for example, from pressure, or by tumours extending from the neighbourhood of a large bronchus to the surface, such as enlarged bronchial glands, mediastinal growths, and aneurismal tumours. The more diffused blowing sounds are due to less complete consolidation. It is essential that the bronchi be patent, in order that bronchial respiration may be heard; thus, in cases of cancerous growth invading a lung from its root and occluding the bronchi, no respiration is audible. As regards mechanism, however, it can scarcely be maintained that the sound is produced by the passage to and fro of the air in the bronchi of the consolidated lung; for (1) at the period when bronchial breathing is most distinct, the lung is immovably fixed by exudation; (2) the play of the chest-wall on the affected side is almost or quite restrained; (3) the air-cells being occupied, there is no reason why air-currents should penetrate the bronchi. Hence it would seem that bronchial respiration is but the glottic breath-sound reverberating through the bronchial tubes, and well conducted to the surface. A remarkable experiment of MM. Bondet and Chauveau (*Revue Mensuelle*, 1877) strikingly confirms this view. In a horse with hepatisation of the base of one lung and bronchial breath-sound over the part affected, the trachea was incised below the glottis, and the wound held widely open; the bronchial breathing immediately disappeared, all respiratory sounds ceasing over this portion of lung, whilst elsewhere the vesi-

cular breath-sound was unimpaired. A musical reed was now inserted into the wound, and the musical sounds were well-conducted over the consolidation, but little audible over the healthy portion of lung.

*Cavernous respiration* is a breath-sound in which the inspiration and expiration have both a hollow blowing quality. It is to the expiration that the hollow wavering quality characteristic of this breath-sound is especially attached, and, as pointed out by Dr. R. Thompson, the expiratory sound is lower in pitch than the inspiratory. Cavernous breathing signifies pulmonary cavity usually phthisical,—(1); exceeding in size an unshelled walnut; (2) either empty or at least partially so; and (3) communicating with one or more patent bronchial tubes. Softening of tubercle or caseous pneumonia, pulmonary abscess, or bronchial dilatation of sufficient size, are the most common causes of cavity in the lung. This abnormal sound is formed by—(*a*) the passage to and fro of air into a cavity with the respiratory movements; (*b*) the conduction and modified reinforcement of the glottic respiratory sound within a cavity.

*Amphoric breath-sound* is a variety of cavernous respiration having the same characters, but on an exaggerated scale; that is, not necessarily exaggerated as regards loudness, but having all the qualities—blowing character and hollowness—intensified. This sound is heard over a large superficial cavity, either in the lung, or in the pleura freely communicating with the lung. Its mechanism is identical with that of cavernous respiration, only that the size of the cavity is large.

(*c*) Adventitious Auscultatory Signs.—A *râle* or *rhonchus* is a sound produced by impediment to the entry or escape of air within the lungs or bronchial tubes. The impediment may be from narrowing, or secretion within the tubes; from secretion within the alveoli; or from destructive softening or œdema of the lung-tissue. The *râles* that may be audible over the chest, are—*sonorous*, *sibilant*, *crepitant*, *sub-crepitant*, *mucous*, *dry crackling*, *moist crackling*, and *cavernous*.

*Sonorous and sibilant râles* are noises of a snoring or whistling kind, which are produced in the air-passages. They are audible with both inspiration and expiration (or with either), and are for the most part transitory sonnds, being temporarily or permanently removed by cough, or in other cases by the relief of the spasm which has occasioned them. They obscure or altogether mask the normal respiratory sounds. Any narrowing of an air-tube will give rise to a sonorous or sibilant *râle* according to the degree of narrowing and the size of the tube. Thus, if the larger tubes be affected, and the narrowing not great, the coarser sound is produced. If, on the other hand, the finer tubes be partially occluded, or a larger tube be greatly narrowed, the finer sibilus is caused. The *râles* are audible throughout the territory of the tubes affected. Thus if a main bronchus be compressed or narrowed, the sonorous *râle* so occasioned will be heard throughout the lung on that side. Throat-sibilus in croup is conducted all over the chest.

The precise causes of these *râles* are—(1) narrowing of a bronchus from external pressure (uncommon); (2) narrowing from local, cicatricial, thickening and contraction of the fibrous coat of the tube (uncommon); (3) mucous collections in the tubes giving rise to imperfect plugs which vibrate, causing the musical sounds (very common); and (4) spasmodic contraction of the medium-sized tubes (sibilus in asthma).

*Dry râles* signify—(1) Bronchial catarrh, or bronchitis, local or general, as the case may be, affecting the larger and medium-sized tubes; (2) tumours pressing upon the trachea or one of the main bronchi; (3) numerous minute bronchial obstructions occasioned by pulmonary miliary tuberculosis; or (4) asthma.

*Stridor* is a variety of sonorous rhonchus, due most generally to pressure of a malignant or aneurismal tumour upon a main bronchus, and heard chiefly over the corresponding side. It is a coarse, vibrating sound, which, however, the trained ear can readily detect to be of distant origin. Paralysis of the vocal cords will, in some cases, lead to stridor.

*Crepitant râle*, or *fine, dry crepitation*, is a minute dry crackling sound, in which the crackles are infinitely small and even, and occupy chiefly the latter part of inspiration. The sound has been compared to the crackling of salt upon the fire, or that produced by rubbing a pinch of hair between the fingers close to the ear. Probably the exact mechanism of the sound is the abrupt separation of alveolar surfaces, collapsed by inflammatory or other œdema. But there are difficulties in the way of any present explanation of the sound. There are at least four conditions which will give rise to identically the same sound, as far as the ear can appreciate it, namely (1) incipient pneumonic consolidation (inflamed œdema stage); (2) œdema of the lungs when not excessive, as in certain stages of kidney-disease, in obstructive heart-disease, &c.; (3) mere collapse of lung from disease, crepitant *râle* being often temporarily heard from this cause at the extreme posterior bases, to disappear after a few deep inspirations; and (4) certain cases of œdema of the pleura dependent upon old lung-disease. The fine crepitation of pneumonia is peculiar only in being associated with commencing tubular breath-sound, the consolidation associated with which gives an increased intensity and definition to the crepitant *râle*. When associated with acute febrile symptoms, fine crepitation indicates the congestive stage of acute pneumonia. If seated about the base, the pneumonia is most commonly of the typical croupous or exudative variety. If at the apex, or in patches, the disease may be incipient catarrhal or embolic (pyæmic) pneumonia.

*Sub-crepitant* or *muco-crepitant râle* is a fine bubbling *râle*, of sharp definition, and well-conducted to the ear, audible principally during inspiration, but in less degree also with expiration. This *râle* is produced in the minute bronchioles and alveoli, by the penetration of air through a thin liquid. A certain amount of lung-condensation is necessary to give sharpness of definition to the sound. Sub-crepitant *râle* is most typically heard in the resolution stage of pneumonia. In the second (secretion) stage

of broncho-pneumonia it is also heard. There are many *râle* sounds intermediate between true dry crepitation and the sub-crepitant *râle*, which are fairly described by the general term crepitant *râle*, fine or coarse, according to their size. Many degrees of fineness or coarseness may be distinguished in different parts of the same lung in some pneumonic forms of phthisis, and it will be generally found in any such cases that the *râles* increase in coarseness as we ascend from below upwards.

*Dry crackle* is the term used to describe a *râle* consisting of three or four distinct small crackles heard during inspiration. The crackles are dry in character, and sharply defined. The inspiratory breath-sound attending this rhonchus is usually feeble and harsh, the expiration harsh and prolonged, but unattended with any *râle*, unless it be some sibilus. Dry crackling most commonly signifies commencing softening of 'tubercular' deposits, and the sound may be most frequently recognised in the sub-clavicular region, where this condition is most often found uncomplicated by conditions depending upon other stages of the disease.

*Moist crackle*, or *humid clicking râle*, consists of a few crackles, heard during the latter part of inspiration and the commencement of expiration, sharply defined, sometimes metallic in quality. The crackles vary in size and in the degree of liquidness, as must be the case from the mechanism by which they are produced. For this *râle* is significant of liquefaction of tubercular or caseous pneumonic nodules in communication with bronchial tubes; and as such adjacent softenings coalesce and increase in size, the crackles become larger, until they develop into the *gurgling* or *cavernous râle*. The moist crackle may be associated with other *râles*, since a softening caseous nodule is often surrounded by congested pulmonary tissue or pneumonia, giving rise to fine crepitant or sub-crepitant sounds. As a rule the breath-sound is more or less masked by the crackling *râle*.

*Cavernous and gurgling râles* are but larger and more liquid *râles*, produced in a cavity or cavities of moderate dimensions.

*Metallic tinkling râle* requires for its development a large empty cavity in which it may be produced—(1) by the bursting of one or more air-bubbles through viscid contents; (2) by the impingement of a drop of secretion against the cavern-wall; or (3) by a bubbling *râle* produced in a bronchus near the cavity, and freely communicating with it. In either case the large empty cavity, necessarily near the surface, resonates and re-echoes the sounds, and gives them their peculiar metallic quality, which has been likened to that produced by a pin dropping into a large empty bottle. Metallic tinkling is by no means solely significant of pleuritic cavity, as was supposed by Laennec; it may be most typically heard over a large dense-walled empty pulmonary cavern.

*Metallic echo* is sometimes confounded with metallic tinkle, with which it is often associated, and, indeed, of which it may be said to form a part. It is really not a *râle* at all, however, but an echo in a large cavity, produced—(1) by air-vibrations caused by cough; (2) by vibrations on the surface of fluid with a large air-space above; or (3) by vocal vibrations reaching through the cavity after true voice-sound has died away.

*Hippocratic succussion-sound* is the splashing sound heard in a pleura containing both air and fluid, on shaking the patient somewhat vigorously, while the ear is applied to the chest-surface.

*Cough-sounds.—A cavernous splash sound* may frequently be heard on listening over a cavity, and causing the patient to cough, the forcible entry of air into the cavity in itself largely contributing to the sound, and setting up gurgling and splashing *râles* by the disturbance of contained fluids.

Cough-sounds require no explanation, but they should be invariably tested in chest-examination. Crepitant sounds are often developed after a cough, which are not to be heard either on ordinary or deep inspiration without it. *Cavities* which are not in free communication with bronchial tubes may yield no characteristic breath-sounds; but the forcible propulsion of air into them at the moment of chest-compression with closed glottis elicits at once a characteristic localised succussion-sound, attended with more or less coarse gurgling *râle*.

*Voice-sounds.*—In the ordinary healthy spongy condition of lung, the voice-sounds are heard but distantly and imperfectly, save in certain parts of the chest in the neighbourhood of the trachea and its bifurcation, that is, in the upper sternal and the upper interscapular regions, where the sounds are better conducted.

*Bronchophony.*—At any portion of the chest where there is consolidation of lung, in association with patent air-tubes, the voice-sound is heard loudly, as though produced near or close, under the stethoscope. Although loudly heard, the sound appears to pass away from under the stethoscope. Any solid medium of conduction between a large bronchus and the stethoscope will give rise to bronchophony, whether by super-position, or by the portion of bronchial tree concerned being imbedded in solid lung, as in lobar pneumonia, of which the sound is most typical. If, however, between the conducting medium and the larynx the bronchial channel be occluded, bronchophony is no longer heard, the voice-sounds being enfeebled or annulled.

*Pectoriloquy.*—If, on the other hand, a cavity be present beneath the spot auscultated, and in free communication with a bronchus, the voice-sound appears to be concentrated at the end of the stethoscope, and to pass *through* the instrument direct to the ear, with exaggerated and even painful distinctness. It is rather the *noise* of the voice that we hear in bronchophony, but in pectoriloquy the sounds are most distinctly *articulated*. This distinction is even better appreciated by listening to a whisper, which under bronchophonic conditions is merely a conducted hissing sound, whilst in pectoriloquy each syllable penetrates distinctly to the ear. Pectoriloquy may, however, be clearly, although not exactly, imitated by consolidated lung in the neighbourhood of a large bronchus. Hence the diagnosis of a cavity near the root of the lung requires much caution.

*Ægophony.*—Ægophony is a form of modified

bronchophony in which the voice-sound, conducted through condensed lung, has further to penetrate a thin layer of fluid in which the coarser vibrations are lost, a certain quavering nasal quality being given to the sound that reaches the ear. It is significant of effusion into the pleura. The sound is only to be heard near the upper limits of the effusion, where the layer of fluid is thin.

With regard to the mechanism of these three sounds—bronchophony, pectoriloquy, and ægophony — there can be no dispute about their being glottic sounds. In *bronchophony* they are conducted through subdividing tubes of increasing fineness enveloped in solid tissue; hence the sounds, although loudly heard, are not well-defined, being largely converted into the coarser vibrations perceptible to palpation as *fremitus*. In *pectoriloquy*, on the other hand, the glottic sounds are conducted through tubes which, after one or two divisions, terminate in a resonating cavity; hence the vocal vibrations are concentrated and conducted with intensity to the ear as through a speaking-tube. Finally, in *ægophony* one may suppose the bleating character of the sound to be due to secondary, and to a certain extent disturbing vibrations in the fluid medium through which the sounds are conveyed. In ægophony one may commonly note a lisp or whisper-sound in addition to the voice-sound, and better conducted than the voice-sound. And it has been affirmed by Bacelli that in cases of *serous* effusion into the pleura the whisper is heard well-conducted with distinct articulation—*pectoriloquie aphonique*—through the thickness of the fluid, whereas in *purulent* effusion such whisper is not conducted. This statement will be found to apply, however, only in certain cases. The whisper may sometimes be heard well-conducted through purulent fluid.

The voice-sounds are *weakened* or wholly *extinguished* by conditions which—(*a*) shut off the main bronchi from the part auscultated, as in malignant growths invading the bronchus at the root of the lung; (*b*) separate the lung-surface from the thoracic wall, as in pleuritic effusions, œdematous thickening of pleura, &c. (Here, however, we must make exception in certain cases, in which pectoriloquie aphonique is heard); (*c*) in rarefaction of the lung by emphysema the voice-sound is enfeebled; and (*d*) in pneumothorax it is either much enfeebled or annulled. In cases of pneumothorax, however, a faint *metallic echo* may often be heard with, or rather after, the voice-sound. This echo has probably a precisely analogous mechanism to ægophony, save that the medium of secondary conduction is air instead of fluid, and hence the conduction is less distinct.

*Autophony.*—On listening over a superficial cavity with condensed lung-tissue around, the voice of the auscultator—for example, when requesting the patient to cough or to speak—will be noticed by himself to be intensified. The term *autophony* is applied to this increased resonance, which is a sign of little clinical value.

*Pleural sounds.*—The sounds originating in diseased conditions of pleura are commonly included under the general term 'friction sounds' —a term, however, very inadequate to describe the varieties.

The *pleuritic rub or dry friction* is a wavy or uneven rubbing sound heard close under the ear with both inspiration and expiration, but chiefly with the former, unmoved by cough, and usually attended with pleuritic pain. We may often fail to obtain this sound, through the patient involuntarily restraining the movement of the affected side on account of the pain. A deep inspiration must, therefore, be always called for. In well-marked cases the friction is very loud and leathery, and may be perceptible to the hand applied—*friction fremitus*.

*Pleural creaking* is a sound that may be sometimes distinguished over a portion of the chest, when the pleuræ are densely thickened and adherent.

*Moist or spongy friction* is most difficult to distinguish from fine moist crepitation. It is heard almost entirely at the end of deep inspiration, and closely resembles the crepitation of a moist sponge. The sound is due to the pleura being adherent by moist, recent lymph, as in the early stage of adhesive pleurisy in pleuro-pneumonia.

In cases of œdema of the pleura a fine crepitating inspiratory sound or *pleural crepitus* may be heard, which it is impossible to distinguish from a pulmonary sound. The diagnosis must rest upon the very superficial character of the sound, and its being unchanged by cough; also upon its being associated with deficient breathing without tubular quality, and with lessened vocal fremitus. It is an inspiratory not an expiratory sound, being engendered by the pulling out of the spongy œdema-tissue during inspiration.

**4. Circulatory System, Physical Examination of.**—The condition of the heart and circulation may be investigated with great exactness, chiefly by palpation, percussion, and auscultation.

PULSE.—The pulse gives us very important information respecting the state of the circulation. For a full description of the pulse and its different characters in disease, *see* PULSE; and SPHYGMOGRAPH.

HEART.—(*a*) **Inspection.**—In health and during quietude the cardiac impulse is barely perceptible. Under excitement, however, throbbing impulse may be noticed over the præcordia and left epigastrium. In cases of great hypertrophy and dilatation of the heart, especially in children, the præcordial region may be obviously bulged. The impulse of the heart may be observed to be diffused over an increased area, between the nipple-line and sternum, in cases of hypertrophy and dilatation. In cases of dilated hypertrophy of the right ventricle, or in displacement downwards of the heart in emphysema, the impulse is very perceptible at the epigastrium to the left of the ensiform cartilage. A diffused undulating impulse may be observed in some cases of pericardial effusion and in adherent pericardium. The heart is often uncovered, and its impulse revealed on one side or the other by retraction of the lung in contractile or wasting pulmonary diseases.

(*b*) **Palpation.**—The position of the heart's apex should first be ascertained; and the area,

force, and rhythm of the cardiac pulsations, and the presence or absence of thrill or other adventitious palpation-signs, should next be noted.

Normally the heart, enclosed in its own pericardial sac, is situated in the anterior and central part of the thoracic cavity, immediately above the diaphragm. Its position may be roughly defined as within the area bounded above by a line drawn across the sternum at the level of the lower border of the second cartilages; on the left by a vertical line passing just within the left nipple; and on the right by a similar line drawn at one-third of the distance between the border of the sternum and the right nipple line. A slanting line from the base of the ensiform cartilage to the upper border of the sixth rib in the left nipple line defines the lower border of the heart. Behind this area the heart lies obliquely, its base directed upwards to the right and backwards, its apex to the left downwards and forwards. The organ, moreover, is so placed that the right auricle and ventricle occupy nearly the whole anterior surface; the left auricle and ventricle the posterior and left surface.

The apex of the heart in the adult impinges in the fifth interspace, one inch within the left nipple line. The aortic and pulmonary valves correspond with the upper border of the third left cartilage at its junction with the sternum, the aortic being on the right of and a little lower than the pulmonary. A line drawn from the middle of the third left cartilage as it joins the sternum, to the upper border of the fifth right cartilage at the sternal margin, would correspond with the mitral valve superficially and above, the tricuspid more deeply and below.

An *altered* position of the apex-beat may arise from congenital displacement of the organ, for example, from transposition of viscera. It may arise from enlargement of the organ by hypertrophy or dilatation, affecting its right or left cavities; or from displacement of the organ, for instance, *downwards*, by emphysema, aneurism, or tumour; *aside*, by pleuritic effusion, malignant disease, or contraction of lung; *upwards*, by abdominal distension, disease in the abdomen, or contraction of lung.

In continuance of palpation, the condition of the arteries and veins at the root of the neck must be observed, whether the arteries unduly pulsate, or the veins on one side or both remain full, or pulsate.

(*c*) **Percussion.**—The præcordial dulness may be enlarged by retraction of the margin of one or both lungs; by effusion of fluid into the pericardium; or by enlargement of the heart itself, either general or restricted to one or more of its divisions. The cardiac dulness may be diminished or obscured by enlargement of the lungs enveloping it, or by air effused into the pericardial sac.

(*d*) **Auscultation.**—By the simultaneous contraction of the ventricles, the closure of the mitral and tricuspid valves, and the impingement of the apex of the left ventricle against the ribs, a single sound is produced, the first sound of the heart. The sudden tense closure of the mitral valve is the principal cause of this sound. The first sound is closely followed by the second sound, which is more tapping in quality, and corresponds with the closure of the aortic and pulmonary valves. Then comes the diastolic pause, which may be said to equal in duration that of the two sounds. The first sound is most loudly heard at the apex, the second at the base of the heart.

The sounds of the heart are subject to considerable variations under varied general conditions of health and disease.

(1) In general debility, anæmia, and wasting diseases, the tendency is for the first and second sounds to approximate to each other in character. As the ventricular wall becomes atrophic or ill-nourished the first sound becomes more purely valvular, and at the same time more feeble and tapping, approaching thus in character to the second sound. Sometimes in cases of anæmia the first sound is peculiarly ringing and hollow in character.

(2) In chronic Bright's disease, with thickened vessels and hypertrophied ventricles, the first sound is peculiarly muffled and indistinct, compared with the recognisable force of the beat.

(3) The rhythm of the heart's sounds may be greatly changed:—(*a*) The first or second, or both first and second sounds, may be reduplicated. This may occur as a temporary phenomenon in apparent health, but it is more commonly traceable to increased resistance either in the pulmonary or systemic circulation. (*b*) Excessive rapidity of action. (*c*) Irregularity in time and force of beats. (*d*) Intermittent action. These several phenomena may be significant of disease of the heart itself; or, as is frequently the case, they may be due to functional disturbance through the nervous apparatus, from dyspepsia; or from excessive smoking, tea-drinking, or venery.

A *murmur* or *bruit* is an abnormal sound, invariably of a blowing character, which may more or less replace or obscure the normal heart's sound. Either of the sounds of the heart may be replaced or attended by a murmur; and in auscultation, with regard to prognosis, it is much more important to note whether a murmur wholly or only partially replaces the normal sound—that is, whether the function of the valve be wholly or only partially disabled—than to be guided by mere loudness of *bruit*. The first sound at the apex may be preceded, or very rarely, succeeded by a murmur. For a description of these murmurs, and of morbid pericardial sounds, *see* HEART, VALVES OF, Diseases of; HEART, Functional Disorders of; and PERICARDIUM, Diseases of.

**5. Mediastinum, Physical Examination of.** Having examined the thorax with regard especially to the great organs, the lungs and heart, contained within it, the mediastinal region should next be explored, both anteriorly and posteriorly.

NORMAL SIGNS.—The anterior mediastinal region, clinically speaking, corresponds with those portions of the sternum not underlaid by lung, namely, the manubrium and the left half of the body, extending from the fourth cartilage downwards.

The lungs normally approximate beneath the upper portion of the second part of the sternum;

from that point to the lower border of the fourth cartilages hiding the subjacent parts. In the triangular space behind the *upper* sternum, with its apex at the lower border of the manubrium and its base at the episternal notch, lie the inferior extremity of the trachea, covered by the left innominate vein, the summit of the arch of the aorta, and a prolongation of the pericardial sac, with connective tissue, and a few small lymphatic glands. The summit of the arch of the aorta corresponds with the level of the upper border of the second rib-cartilage.

Imperfect percussion-dulness and modified bronchial respiration, with weakly conducted heart-sounds, are usually presented over this region. On deeply depressing the finger behind the sternum in the episternal notch, a slight pulsation, communicated from the aorta—which vessel, however, the fingers cannot reach, is felt. The lower region of mediastinal dulness, that is, below the fourth cartilage level, is continuous on the left of the sternum with the heart's dulness, and indeed, corresponds with the præcordial region.

Morbid Signs.—The *upper* mediastinal dulness may be replaced by resonance—(1) from enlargement of the lungs in emphysema; (2) in cases of contraction of the upper part of one lung, enlargement of the opposite lung wholly occupying the sternal region, and effacing the normal mediastinal dulness. The limits of normal mediastinal dulness may be *extended*, from displacement of the anterior margin of the lungs—(1) by dilatation or aneurism of the aorta; (2) by mediastinal abscess; (3) by simple enlargement of the mediastinal or thymus glands; or (4) by morbid growth, cancer, or lymphoma. For the diagnosis between these several conditions *see* Aorta, Diseases of; and Mediastinum, Diseases of. It must be borne in mind that considerably increased dulness, and even prominence, may be due to intrinsic disease of the sternal bone, or to thickening from periostitis.

Alterations in the boundaries of the *lower* region of mediastinal dulness are most often due to enlargement of the heart, or dilated pericardium. Aneurism of the aorta or the heart, or a growth extending forwards, between the heart and the lung, from the posterior mediastinum, are the other causes of increased inferior mediastinal dulness.

*Posteriorly* there is no inter-pulmonary space apparent save that occupied by the spinal column. But in disease, and especially in tumour, whether aneurismal or of the nature of morbid growth affecting the root of the lungs, the posterior mediastinal dulness involves the right or left interscapular region, as the case may be.

The bifurcation of the trachea corresponds with the body of the fourth dorsal vertebra. The descending portion of the arch of the aorta corresponds with the left side of the third dorsal vertebra.

**6. Abdomen, Physical Examination of.**—The abdomen is that portion of the body included between the diaphragm above and the brim of the true pelvis below; and is usually divided, for convenience of clinical reference, into regions. Two horizontal lines drawn at the level of the ninth ribs, and the highest point of the crest of the ilia respectively, and intersected by vertical lines drawn from the eighth rib on each side down to the centre of Poupart's ligament, divide the abdomen into nine regions, namely, epigastric, umbilical, and hypogastric in the centre; and hypochondriac, lumbar, and iliac on each side, from above downwards.

(*a*) **Inspection.**—When examining a case of abdominal disease the position naturally assumed by the patient should be noticed—whether it be indifferent; or dorsal with the knees drawn up—a position very characteristic of peritonitis; or lateral, with the thighs flexed and the body bent, as in renal or hepatic colic. Sometimes in cases of colic, especially lead-colic, the patient lies on his belly with the arms compressing the part. Frequent changes of posture are also characteristic of colic rather than of peritoneal inflammation. The general size, shape, tenseness, fluidity, or retraction of the abdomen will be next observed. Any alteration from perfect symmetry will be noted, with the region of any swelling. The superficial veins of the abdomen may be enlarged, the internal mammary from above meeting the superficial and deep epigastrics, to secure collateral circulation between the superior and inferior cavæ, when either is from any cause compressed or occluded.

(*b*) **Palpation.**—On placing the hand over the abdomen for the purpose of palpation, the rigidity or otherwise of the muscles, especially of the recti, will be noticed; and the observer will be careful to note whether the muscle becomes contracted during manipulation, or was from the first unduly tense. The muscles of the abdominal walls are rigid, as a rule, in all inflammatory conditions of the peritoneum. In local peritonitis, and over special organs or tissues which are painful, the muscles are also tense; thus it is not uncommon to find one rectus notably more rigid than its fellow.

In order properly to examine the abdomen by palpation, it is necessary to place the patient flat on his back, on a slightly inclined plane, with a round pillow placed under the head, so as to flex the chin upon the sternum. The thighs should be similarly flexed upon the pelvis by means of a second incline, on which the legs should rest, or by placing one pillow beneath the thighs and two pillows beneath the legs. In this manner the muscles of the abdomen will be rendered as lax as possible. The patient should further be held in conversation, or told to breathe deeply but without effort, in order that he may not keep his diaphragm fixed. It is often a good plan, when other efforts fail to prevent the patient from keeping his diaphragm fixed, to make him go on counting 'one,' 'two,' 'three,' up to as high a number as he can possibly reach without drawing breath. In this manner we get the diaphragm thoroughly relaxed; and by keeping the hand on the abdomen, deep palpation can be effected at any period of the counting most suitable for the purpose. The observer should be comfortably placed at about the same level as his patient. The whole hand, previously warmed, should be evenly applied to the surface, and the fingers then depressed in different directions as the hand is smoothly conveyed to different regions. If the

patient be poked about with the ends of the fingers by the physician stooping over him he is either tickled or hurt, his muscles contract, and proper examination is impossible.

It is sometimes useful to make the patient change his position first to one side, then to the other. This method is particularly to be adopted in examining tumours which are movable, such as floating kidneys, some uterine tumours, and aneurismal sacs. In the case of tumours lying over the aorta, it may be impossible, without adopting this plan, to be sure whether the pulsation felt over them is communicated or intrinsic.

It is sometimes doubtful whether a tumour is situated within the rectus muscle, or in the abdomen beneath it. By keeping the hand over the tumour and making the patient raise himself half to the sitting posture, so as to cause the recti to start forward in contraction, this point can be cleared up.

The temperature of the surface of the abdomen to the hand applied, and to the surface thermometer, may be distinctly raised above that of the general surface in peritonitis.

It is often difficult to estimate the true degree and nature of pain in the abdomen caused by pressure. In hyperæsthesia of the surface the slightest pressure causes suffering; whilst deep, even palpation gives little inconvenience. If the surface be pinched up the pain is acute. Pain in the abdominal muscles is less acute, and is intensified by bringing these into action. The pain of peritonitis is superficial in so far as it is commonly associated with hyperæsthesia of surface; but gentle, steady pressure is acutely painful, and deep palpation intolerable. The pain of peritonitis may, with the disease, be general or local. There is often some difficulty in differen tiating the pain of localised hyperæsthesia—hysterical pains as they are called, from those of inflammatory origin or from tenderness of organs. By holding the patient persistently in conversation respecting symptoms associated altogether with another part, as minute inquiries about headache, cough, &c., and thus keeping off attention whilst the hand is steadily compressing the supposed painful parts, all doubts can be removed. In neuralgic and hysterical pains simulating peritonitis, the tenderness extends beyond the confines of the peritoneum.

Abdominal organs may be tender to palpation.

*Fluctuation.*—Fluctuation is an important sign of the presence of fluid in the abdomen, whether the fluid be free in the peritoneum or enclosed in a sac. It may be obtained by placing one hand lightly on the abdomen, whilst the fingers of the other hand smartly tap over another part, when a fluid wave will be felt to impinge against the applied hand. In certain tense conditions of the abdomen, a deceptive sense of fluctuation may be obtained from the vibrations of the abdominal walls. To prevent this fallacy the hand of a bystander should be applied edgewise on the abdomen, midway between the two hands of the observer, so as to check superficial vibrations.

*Hydatid fremitus.*—This is a kind of tense fluctuation appreciable by the pleximeter finger on sharp percussion over certain cysts, more particularly hydatid cysts.

(*c*) and (*d*) **Percussion and Auscultation.**—Percussion and auscultation of the abdomen are adopted in accordance with the methods already described. The distribution of dulness and resonance, varying or not with the position of the patient, affords important evidence respecting fluid collections, whether peritoneal or encysted. *See* ABDOMEN, Diseases of; and ASCITES.

By auscultation friction-sounds may be heard over the seat of peritonitis; vascular, aneurismal, and placental bruits; or the sounds of the fœtal heart may be detected.

PHYSICAL EXAMINATION OF THE LIVER.—In the right mammary line the liver underlies the region from the fifth rib to the costal margin; in the median line from the base of the xiphoid cartilage to an inch and a half below that level. The left extremity of the liver lies just within and behind the apex of the heart. It may, then, be roughly said that a horizontal line drawn from the base of the xiphoid cartilage to the right side of the chest and to the apex of the heart, and a second line slanting from within the apex-beat to the right costal margin in the nipple line, would mark the site of the liver. It has already been observed how this surface is partially covered above by lung. In health the margin of the liver becomes lost to palpation beneath the cartilages in the right nipple line. Its upper margin may be defined, as already shown, by deep percussion, its lower margin by very light percussion.

*Displacements.*—The liver may be *lowered* in position by certain thoracic conditions, such as emphysema, fluid in the pleura or pericardium, thoracic tumours, or compression by tight-lacing. When the liver is thus lowered, it is somewhat anteverted; and in lax conditions of the abdomen its lower margin may be covered by a coil of intestines, thus requiring somewhat deep palpation in tracing it.

The liver may be *raised* by contractile thoracic diseases, especially on the right side, so that its margin recedes considerably within the costal margin. In cases of doubt as to whether extension of dulness upwards be liver or lung-consolidation, the observer must notice whether the level be shifted by respiratory movements. When the abdomen is distended from any cause, the liver is pushed upwards; and in this case, and also in many instances where the liver is drawn upwards, it becomes also tilted somewhat backwards, so that but little more than the margin presents anteriorly. In this condition there may be but little, if any, liver-dulness discoverable anteriorly, and it may erroneously be concluded that the liver is much diminished in size. In these cases, however, the posterior dulness of the liver is increased in the right lower thoracic region. In cases of enlargement of the liver, therefore, the upper margin must be accurately defined, to see if there be extension upwards, and whether that extension be even or uneven. The lower margin must be traced by palpation; the *mobility* of the organ with respiration estimated; its hardness, softness, sharpness, evenness, or distortion ascertained; and whether it be free or connected with other

parts—for example, the spleen, or an abdominal tumour.

The lower margin of the liver, when the organ is enlarged or depressed, very frequently cannot be defined by percussion, being overlapped by intestines. For instance, in cases of lax abdominal parietes, with moderate fluid effusion in the peritoneum, the intestines float up and press between the margin of the liver and the surface. In other cases the front surface may be unduly rounded, and the margin thus incurvated to a certain extent and covered by intestines. The *surface* must be felt—whether smooth, or rough, or nodulated. The *consistence* must be estimated by palpation—whether hard or soft, or fluctuating at any part.

The *gall-bladder* cannot be felt unless it be distended, when it presents as a rounded tumour attached to the margin of the liver in the right nipple line.

Physical Examination of the Spleen.—Normally, splenic dulness may be ascertained on light percussion in an area on the left side extending from the ninth to the eleventh ribs, and between the mid axillary and mid-scapular lines. The shape of the splenic dulness is oval in the slant of the ribs.

In moderate *enlargement* the splenic dulness is increased in all directions; and on placing the hand deeply in the left flank, close under the ribs, the organ may be felt to descend upon it during inspiration. As the organ still enlarges it comes forwards and downwards, raising the apex-beat of the heart, occupying the region in front of the scapular line and below the level of the apex-beat, and projecting downwards beneath the costal margin into the abdomen. As the organ still further enlarges, the anterior margin curves forwards, forming nearly a right angle with the costal margin. It is usually sharply defined, and may extend forwards to the median line, and downwards to the pelvis. The posterior margin of the enlarged spleen is also, in such cases of great enlargement, to be felt thick and rounded immediately in front of the quadratus muscle. An enlarged spleen extending into the abdomen is superficial in its entire area; its anterior and posterior borders are well-defined; and it can usually be moved between the two hands forwards and backwards The notch may be commonly felt. The surface may be quite even or nodulated. Sometimes on auscultation a bruit may be audible over an enlarged spleen. Friction-sound may also sometimes be heard. Certain alterations in the constitution of the blood and in the temperature of the body are intimately associated with diseases of the spleen, and the examination of these conditions forms an important item in their diagnosis.

*Diminution* in the size of the spleen cannot be accurately estimated, and is of little clinical moment.

Physical Examination of the Kidneys.—The kidneys, when of normal dimensions, cannot, as a rule, be felt, especially in fat people, or when the abdomen is enlarged. They lie one on either side near the spinal column, between the level of the spinous process of the eleventh dorsal and of the second lumbar vertebræ, and in the mid-line between these spinous processes and the outer margin of the flank. Imbedded in fat, they rest on the lumbar muscles. The right kidney is overlain in part by the liver, colon, and intestines; the left by the stomach, colon, and intestines.

In order to feel for the kidney, the patient should be placed in the position for abdominal examination. The observer, standing on the side opposite that of the kidney under examination, then places one hand along the mid-flank behind, immediately below the last rib; the other hand should rest upon the corresponding part of the abdomen in front, firmly depressing and manipulating deeply, so as to bring the site of the kidney between the phalangeal portions of the two hands. At the same time the patient should be made to inspire and expire deeply; and it is during the stage of moderately deep expiration that the organ will usually be felt.

*Tenderness* of the kidney, if present, may thus be estimated with certainty. Undue rigidity of the muscles on one side may be observed.

If the kidney be *uniformly enlarged* it simply extends downwards, and comes more readily under observation. In great enlargement of the kidney, as in cancerous tumour, or of its pelvis, as in pyelitis, the organ forms a tumour occupying the flank, and coming forwards from behind the colon towards the front of the abdomen. Such a tumour is more or less pyramidal or rounded in form, with a distinct band of resonance corresponding with the superior flexure of the colon extending across it. The tumour may be solid or fluctuating, according to its nature. Renal tumours are most common on the left side. The pelvis of the kidney, except when considerably dilated, does not come under palpation. *See* Kidneys, Diseases of.

*Movable kidneys.*—The mobility of the kidneys varies much, from mere laxness to complete dislocation. *See* Kidneys, Diseases of.

*The examination of the urine* forms the most important part of the physical diagnosis of kidney-diseases. *See* Urine, Morbid Conditions of.

Physical Examination of the Pancreas.—In thin subjects with retracted abdomen, the head of the pancreas may be felt as a small, somewhat angular, tumour to the right of the median line, above the level of the umbilicus, in the region, in fact, of the pylorus, with thickening of which it may readily be confounded.

Cancerous enlargement of the pancreas extends forwards, in or near the middle line, above the umbilicus, presenting a tumour difficult to diagnose. *See* Pancreas, Diseases of.

Physical Examination of other Abdominal Viscera.—Diseases of the *stomach* and *intestines* yield their proper signs, requiring no separate description here. Tumours of the *omentum* have to be distinguished, by the method of exclusion, from affections of the solid organs of the abdomen.

The *pelvic organs*—uterus, and ovaries, and bladder, under certain conditions of enlargement—present themselves for diagnosis as abdominal tumours.

When distended, the *bladder* gives rise to a pyramidal area of dulness extending in the median line from the pubes, broadening upwards, towards or even beyond the umbilicus. The tumour is firm but elastic, on palpation tender,

and is at once removed by successful catheterisation.

In pregnancy at the fourth month the *uterus* becomes perceptible to deep palpation in the pelvic basin in the pubic region. At and beyond the fifth month a tumour of growing dimensions extends from out of the pelvis towards and beyond the umbilicus. Dulness on percussion extends from the pubes over the whole front of the tumour, whilst above and in the flanks a resonant intestinal note is obtained. The relations of dulness and resonance are not appreciably changed by position. The tumour is elastic, and in the advanced stages obscurely fluctuating. On deep palpation, an irregular resisting lobulated mass is to be felt, and on keeping the hand steadily applied, undulating movements, or a distinct shock or jerking movement, may from time to time be felt. On applying the stethoscope with somewhat deep pressure, half-way between umbilicus and pubes and a little on one or other side, the rapid beat of the fœtal heart may be distinctly heard, closely resembling the tick of a watch under the pillow. On bringing the stethoscope nearer the inguinal region (usually on the right side), the soft low-pitched placental *souffle*, synchronous with the maternal pulse, is to be heard. Enlargement of the uterus from other causes, especially fibroid and fibro-cystic growths, may lead to abdominal tumours, which are diagnosed by combined vaginal and abdominal examination. *See* Womb, Diseases of.

*Ovarian* tumours also present in the abdomen, extending upwards from one or other side of the pelvic region, and with a disposition as they extend to become central. They are most commonly cystic, and—especially in the later stages—sometimes present difficulties in diagnosis from pregnancy or peritoneal dropsy. *See* Abdomen, Diseases of; Abdominal Aneurism; Aorta, Diseases of; Ovaries, Diseases of; and other appropriate headings.

R. Douglas Powell.

**PHYSIOGNOMY** (*φύσις*, nature, and *γνώμη*, judgment).

Definition.—Physiognomy originally meant the interpretation of the nature of an individual, by the light of the indications afforded by his countenance, conformation, and movements; but the term is frequently used for the indications themselves.

Physiognomy in Diagnosis. — In the early ages of medical science the doctrine of physiognomy formed an important part of all systematic teaching. In proportion as the means and practice of physical diagnosis have been developed, physiognomy, being insusceptible of exact treatment, has fallen into the background, and is seldom assigned a definite place among methods of investigation. Yet in every description of disease the indications yielded to inspection have their place; and practically it is no small part of the accomplishment of a skilful physician to be able to recognise readily in any sick person the outward signs which may be characteristic of his malady.

The authors who have treated systematically of physiognomy make it, in the first place, subservient to the definition of certain morbid temperaments, to which the name of *diatheses* has been given. When in any case the tendency belonging to a diathesis has gone on to the production of an actual diseased state, the word *cachexia* has been commonly adopted to express the fulfilment of the first physiognomical prophecy, with an extension of application to diseased states produced by accident, or without precedent sign of the existence of the corresponding diathesis. Among modern English authors on medicine, Dr. Laycock was conspicuous in allotting an important place to the 'physiognomical diagnosis of morbid constitutional states.'

Elements of Physiognomy.—Besides such larger groups of physiognomical indications, there are smaller groups, and even single features, which relate to particular systems of organs, or to individual parts, and which, in proportion to their limitation, have mostly a more precise meaning. Before enumerating some of these, it may be of advantage to review the elements of physiognomy. These are, in the main, four:—1, *tegumentary*—skin, with glands and blood-vessels, mucous membrane of mouth and throat; 2, *muscular*; 3, *skeletal*; 4, *attitudes* and *movements*, including those of speech.

The *skin* presents a large number of points for observation; for example, its colour, as regards pigmentation, and as regards vascularity; its texture, as regards softness or hardness, smoothness or roughnesss, thickness or fineness, toughness or flexibility, dryness or moisture; the development and distribution of glands and hairs; œdema; tumours, such as warts; and eruptions. Besides these, in the face lines, furrows, and ridges mark the excessive or defective action of particular muscles, whether determined by habit or disease, causes which also determine the shape of the orifices and skin-prominence of the face.

As regards *muscular* variations there may be noted protective contractions, to which Mr. Darwin has drawn attention as part of the basis of the expression of the emotions, protective relaxation, reflex contractions, spasmodic contractions, and paralysis. With the conformation of the *bones*, which form the framework upon which the skin and muscles are moulded, must be associated the teeth, organs rich in information touching the health of the mucous membranes during childhood, and of the system at large throughout life.

Applications of Physiognomy.—Many of the correlations between physiognomy and disease are fully discussed in other parts of this work. A few illustrations of the use of the method may, however, be cited in this article.

The *skin*, alone, may yield indications suggestive, pathognomonic, or diagnostic, as the case may be. Of the first kind are the staining of jaundice, the contrasted tints of hectic, the alterations of the hair in various diseases; of the second kind are the eruptions of exanthematous fevers and syphilis; of the third kind is the observation of Mr. Spencer Wells, in dealing with the diagnosis of ovarian and uterine tumours, that 'there is a facial expression common to women suffering from both classes of disease, associated with a very florid complexion when the tumour is uterine, whereas in the majority of

ovarian cases the complexion is pallid.' In the mucous membrane of the mouth the blue line on the gums in chronic lead-poisoning, the spongy gums of mercurial-poisoning and of scurvy, and the pigmentation of Addison's disease are, approximately, instances of the three kinds of signs.

In the *muscles*, independently of the various evidences of paralysis, we may refer to the 'risus sardonicus'; to the tumid, expressionless upper lip of progressive muscular atrophy (Duchenne); to the fixed bent attitude of the head, and rigid, imperturbed features and unaltered articulation of paralysis agitans, as compared with the shaking head and scanning articulation of disseminated sclerosis, or the fatuous look which accompanies the irregular movements of chorea. The physiognomy in plague is said to be highly characteristic. *See* PLAGUE.

The *bones* contribute also to our information. They present definite changes of form in rickets, the projecting under-jaw which in many women is associated with pelvic deformity, the enlargement of the cranium in hydrocephalus, and the hour-glass head and altered teeth of inherited syphilis.

As in the diatheses all the four systems co-operate to form a characteristic physiognomy, so in many actual diseases complex manifestations are abundantly presented. The changes observed in the face and neck in association with certain affections of the chest may be selected as illustrating well this kind of grouping. Thus in severe cases of chronic bronchitis, with emphysema, the skin is turgid, blue, purple, or livid, the lower lip especially being discoloured, enlarged, and everted; the veins, particularly in the neck, are full and prominent; the brows are knitted, the eyeballs projected, the eyelids swollen and partly contracted; the lower jaw, if not closed, is rigidly set in a way to give full effect to the action of the central muscles raising the sternum, which, with the sterno-cleido-mastoids, are prominent and strong; the head is bent forward, the shoulders raised, the nostrils expanded and thickened. The entire expression is one of strain and anxiety. If there be, as is often the case, tricuspid regurgitation, the veins of the neck may be seen filled during every pulsation of the heart.

In certain forms of advanced disease of the heart there is the same swelling and discolouration. But there is usually some icteric tinging of the skin and conjunctivæ, and much weaker signs of muscular strain, which in emphysema are brought about by the constant inspiratory effort. The face is generally calmer in expression, and the head rather thrown back than drawn forward.

When an aneurism or intrathoracic growth presses on the structures in the upper part of the chest, the face often presents enormous venous turgidity, and the veins at the root of the neck are often permanently distended, and unaffected by the movements of respiration, sometimes on one side, sometimes on both. If there be pressure on the trachea or large bronchi, or if there be paralysis of the recurrent laryngeal nerve, many of the muscular strains already noticed may be present; if there be paralysing pressure on the sympathetic, the pupil on the same side will be comparatively contracted, all the tissues on the side more swollen, and the secretions increased. If with aneurism there be aortic regurgitation, violent pulsation of all the arteries will usually be noticed, bringing into strong relief arteries generally quite unseen.

In these illustrations the appearances seen in the head and neck only are considered. If the modification of bodily conformation, movements, and attitudes which go to make up the full physiognomical picture were also detailed, a large addition, exceeding the limits of this article, would be involved. But even so much as is here portrayed will serve to remind us of the large amount of suggestive information which may be gleaned by the observer before proceeding to actual physical examination of the patient, and may stand for an example of the process which, under careful training and practice, is at last performed almost unconsciously by the experienced physician.

WILLIAM M. ORD.

**PHYSOMETRA** (*φῦσα*, air, and *μήτρα*, the womb).—A condition in which a collection of gas or air is formed in the uterus. *See* WOMB, Diseases of.

**PHYTOSIS** (*φυτὸν*, a plant).—A generic term for plant-formation, applicable to epiphytic, phytiform, or parasitic diseases of the skin, of which there may be enumerated the following species:—*Phytosis* or *tinea tonsurans*; *phytosis* or *tinea circinata*; *phytosis favosa* or *favus*; and *phytosis versicolor*. *See* FAVUS; NOSOPHYTA; RINGWORM; and TINEA.

**PHYTOSIS VERSICOLOR.**—SYNON.: Willan, Fr., and Ger. *Pityriasis versicolor*.

DEFINITION.—A disease of the epidermis, rete mucosum, and follicular epithelium, characterised by the development on the skin of a yellowish-brown discolouration, sometimes tawny and sometimes olive; consisting of small, irregularly-shaped patches and blotches of considerable extent, which give to the integument a variegated or mottled appearance.

ÆTIOLOGY.—The presence of phytosis versicolor indicates defective nutritive power of the skin, which is not infrequently associated with general debility, and sometimes defect of sanguification—with such symptoms, in fact, as are present in melasma; but these symptoms are rarely very prominent, and the general inference may be that the health is unaffected.

DESCRIPTION.—The most common seat of phytosis versicolor is the trunk of the body, where it assumes a symmetrical distribution, sometimes spreading down the flanks from the axillæ, sometimes occupying the middle line, and sometimes the whole surface of the abdomen, or descending from the groins upon the upper part of the thighs, like an apron. It is found similarly disposed on the back of the trunk, or it surrounds the neck, blending with a general swarthiness of the face; and it is likewise met with on the upper arms, the flexures of the elbows, and those of the knees.

When closely examined, it may be seen that

the discoloured skin is punctated by the apertures of the follicles, which are deeper tinted than the rest of the surface, and seem to perform the office of centres, from which the pigment spreads around, involving other follicles similarly affected. This inspection tends to satisfy us that the follicles are the origin of the morbid process and discolouration. Another observation, derived from close inspection, is that the patches are slightly elevated, and that they present evidence of hyperæmia; and, further, we discover that they are very apt to take on a ragged kind of exfoliation, which has gained for the disease the synonym of *pityriasis*.

Therefore, the distinguishing characters of this affection are its colour; its patchy distribution; its exfoliation, from the breaking up or crumbling of the morbid epidermis; and the subjective symptom of itching. These characters present considerable variety. In some instances the colour of the disease predominates so considerably as to suggest a pigmentary affection simply; in others the exfoliation is so remarkable that the term pityriasis would seem to be fairly warranted; while in others, again, the itching may be either almost absent or insufferable.

When a portion of the exfoliating epidermis is submitted to the microscope, it is found to be largely composed of minute globular bodies or cells, which are rendered transparent by the addition of a solution of potash. These are presumed to be a fungous vegetation, and to the individual globules the term *microsporon* has been applied.

Phytosis versicolor is a malady which is chiefly inconvenient from its appearance, and may exist for years without giving rise to any disagreeable symptoms. Sometimes there is a little pruritus, when the patient becomes warmed by exercise; but occasionally the itching has been found so troublesome and unbearable as to be a source of considerable suffering.

Although, in consequence of being considered one of the parasitic diseases, phytosis versicolor has been credited with the reputation of being contagious, it is very rarely met with in both husband and wife, however long it may have been present in either. Unlike tinea, it is a disease of the adult; and tinea is never attended by pigmentation.

Sometimes it exists for years without attracting the attention of the patient further than the inconvenience of its appearance, and it rarely gets well without treatment.

Diagnosis.—The diseases with which phytosis versicolor is liable to be confounded are the pigmentary affections, melasma and chloasma, and pityriasis. The presence of slight elevation, exfoliation, and its flecked appearance, as well as its symmetrical distribution, will distinguish it from the smooth stains of the former; and the absence of inflammation, with exfoliation rather than desquamation, from the latter.

Treatment.— In the treatment of phytosis versicolor, tonic remedies and a tonic regimen are generally indicated. Locally, it yields very quickly to the sulphuret of potassium ointment, to all the mercurial ointments, or to a lotion of perchloride of mercury ointment in almond emulsion. The use of sulphur soap is also valuable, and by keeping up a moderate stimulation of the skin, it tends to check the return of the disease. *See* Tinea.

Erasmus Wilson.

**PIA MATER, Diseases of.** *See* Meninges, Diseases of.

**PIARHÆMIA** (πῖαρ, fat, and αἷμα, blood).—A morbid condition of the blood, in which it contains free fat. *See* Blood, Morbid Conditions of.

**PICA** (*pica*, a magpie).—A perversion of appetite, characterised by a craving for various substances unfitted for, or incapable of digestion. *See* Appetite, Disorders of.

**PIGEON-BREAST.**—A deformity of the chest, in which the ribs are flattened laterally and the sternum thrust forward, so that the chest assumes somewhat the shape of the breast of a pigeon. *See* Deformities of Chest.

**PIGMENTARY SKIN-DISEASES.**—Synon.: *Chromatopathia*; Chromatopathic affections.

These affections may be arranged under four heads, namely:—1, *defect*; 2, *excess*; and 3, *alteration* of colour: and 4, *artificial colouring* of the skin.

1. **Defect of Colour.**—Defect of colour of the skin is due to absence of pigment; it occurs both in the rete mucosum and hair, and is either general or partial. As a general affection it is known by the name of *albinism*, the subject of the defect being called an *albino*. Considered as a disease it is termed *leucopathia* and its examples are achroma, leuce, and leucasmus. *See* Albinism.

2. **Excess of Colour.**—Excess of colour is represented by increase in quantity of the normal pigment of the skin, giving rise to a series of shades of hue, ranging from the lighter tints of olive and brown to the deepest tints of black; and, like the preceding, may be general or partial. As a morbid process it is denominated *melanopathia*, and its examples *chloasma* and *melasma*.

3. **Alteration of Colour.**—Alteration of colour of the skin is manifested by a variation in hue of the pigmentary matter, arising from an excess of one of the primitive elements which enter into the composition of the normal brown or black. Thus it may be yellow or olive, as in the two principal members of this group, ephelis and lentigo, the general term for the affection being *xanthochroia*; whilst the term *cyanochroia* has been applied to a rare example of blue pigmentation of the skin.

4. **Artificial Colouring of the Skin.**—This is shown in the leaden or slate-coloured hue resulting from a prolonged use of the salts of silver as an internal remedy. The seat of the discolouration is the papillary layer of the corium, and not the rete mucosum; and the affection is termed *argyria* or *melasma tinctum*. Here also may be mentioned the yellow and green pigmentation of the skin of jaundice, and the blue, green, and yellow stains of a bruise; with the reservation, that they are temporary, being due to bile or the extravasation of blood, whilst the colour produced by the oxidation of silver in the tissue of the derma is permanent

Ætiology and Pathology. — Pigmentary affections may be said to be due to derangement of function of the integument consequent on disturbance of nutrition. Thus, in natives of tropical countries a slight functional disorder may occasion arrest of pigment-formation of varied extent, and become the cause of *achroma*, as we see illustrated in the instance of the pied negro. Similar effects may be produced by hyperæmia of the skin, as in the case of varicose veins; and again by deranged innervation, as in nervous shock and prurigo. And to these several causes, namely, deranged nutrition, hyperæmia, and altered innervation, all the known examples of melanopathia and leucopathia may be traced.

One of the commonest forms of *melasma* is a natural concomitant of a delicate skin—for instance, lentigo, which, when it appears on the face, may be attributed to the sun and light, but occurs on the covered parts of the body as well. *Ephelis solaris* and *ephelis ignealis* result from the action of heat; a pigmentary stain not infrequently follows the use of a blister; and melasma is a common consequence of varicose veins. Associated with a slight inflammation of the papillary layer of the derma we have pityriasis versicolor, and with the more extensively deranged nutrition of the integument in syphilis, the form of melasma termed 'copper colour.' Morphœa and scleriasis are accompanied with achroma, as well as with melasma; and elephantiasis in even a greater degree. Arsenic, when prolonged in its use for a considerable time, is a cause of melasma; and several chronic diseases of the skin are succeeded by a melasmic stain.

Another series of cases derive their origin by reflex action, or directly, from the nervous system. The *melasma palpebrarum*, which in some females accompanies every menstrual period, is often exaggerated in dysmenorrhœa. In pregnancy, melasma of the areola of the nipples is a normal occurrence, but there are often, superadded to this, *chloasma* or *melasma frontis* or *faciale*. Melasma, again, with achroma, is not infrequently associated with hysteria, nervous shock, and notably with Addison's disease, the so-called 'bronzed skin;' and melasma is a constant attendant on prurigo.

As an aberration of function melasma and achroma indicate a feebleness of skin, as well as more or less constitutional debility; and, as such, they are occasionally associated with grave disorder of the general health. Lentigo, ephelis, and chloasma may be of trifling portent, but *melasma faciale* often indicates a wearying disturbance of the uterine system; the melasma of prurigo a troublesome derangement of the peripheral nervous system; the melasma and achroma of syphilis and elephantiasis a serious dyscrasia; and the melasma of Addison's disease a dangerous and often fatal state of disease.

Prognosis.—The prognosis of a return of the skin to its normal state is decidedly unfavourable, and these discolourations will often endure for a lifetime.

Treatment.—As the greater proportion of pigmentary affections are symptomatic of constitutional disorder, the latter will demand an appropriate treatment, whilst the discolouration is dealt with by local remedies. Addison's disease, the neuroses, the dystrophic affections—morphœa and scleriasis, and the dyscrasic affections—syphilis and elephantiasis, require a treatment suited to their respective nature. Parturition and cessation in the use of arsenic withdraw the constitutional cause of chloasma and *melasma arsenicale*, and the removal of local irritants, as in ephelis, tends to their cure. But as the local effect will frequently continue even after the constitutional or exciting cause is withdrawn, we are led to consider the best form of local treatment. Our most trustworthy remedies for the purpose of removing pigmentary stains are alkaline lotions and ointments, headed by soap; lotions of acetic and hydrochloric acid; iodine and iodide of potassium. A lotion of perchloride of mercury in almond emulsion is commonly resorted to for freckles and the slighter forms of discolouration. The pigment is invited to return in achromatous spots by the stimulation of cantharides. In every form of pigmentary discolouration stimulation by friction is also serviceable. Erasmus Wilson.

**PIGMENTATION, Morbid.**—Definition. A morbid process, consisting in the deposition of colouring matter in situations where it does not normally occur, or in excess in usual localities.

Description.—The abnormal deposition of pigment may take the form of an uniform staining of the tissues, as in icterus; or it may occur in patches, varying from mere specks up to a very considerable size. The colouration may affect the skin (*see* Pigmentary Skin-Diseases), or the mucous membrane, as in Addison's disease, where patches of pigmentation are frequently seen on the palate and inside of the cheeks; or the pigment may be deposited in granular masses in the substance of organs, such as the liver, brain, spleen, kidneys, lymphatic glands, and medulla of bones. New growths, both of the epithelial and connective-tissue type, may be the seat of extensive pigmentation, especially if the tissues with which they are connected be normally the repositories of colouring matter (*see* Melanosis); but the change is by no means limited to such situations. Considerable variety is presented in colour. The various shades of black and brown are usually attributed to the existence of a substance called 'melanin,' though there is reason to believe that several different pigments are included under this term. In chemical composition melanin contains carbon, oxygen, hydrogen, nitrogen, and iron; in this latter respect resembling hæmatin. 'It is soluble in ether, alcohol, water, and acids; also in boiling caustic alkalies, thus distinguishing it from particles of carbon' (Gamgee).

The bile-pigments are obviously the cause of icteric staining. The very exceptional and remarkable condition of *cyanoderma* is attributed to the presence of indigo; whilst the excessive ingestion of such minerals as lead and silver is liable to be followed by a bluish line around the gums, or a purple colouration of the skin. As in the retina, choroid, and Malpighian layer of the skin, pigment most frequently occurs in epithelial cells, though not unusually in free granules and flakes.

Pathology.—Excepting when the colouring

matters are obviously introduced from without, the morbid, like the normal pigments, are derived more or less directly from the hæmatin of the blood, itself a reddish-brown substance. Their presence is associated with two very opposite conditions of nutrition, being sometimes an accompaniment of tissue-degeneration and diminished function, at other times connected with extremely active trophic changes. It is noticeable that the chlorophyl of plants and hæmoglobin of blood are amongst the earliest differentiated and most widely distributed proximate principles, intimately dependent upon which are the respiratory changes of plants and animals. The pigmentary layer of the retina, the visual purple, and the wide-spread occurrence of pigment in the nerve-centres, are among the most striking examples of the connection of colouring matter with normal functional changes. Melanotic growths, which are usually of remarkable activity, the temporary brown patches on the skin (*melasma*) in the neighbourhood of painful spots in neuralgia and some uterine states, and the occasional sudden loss of colour in the hair from mental disturbance, are illustrations of morbid nutrition in the same direction. In the majority of cases where pigment is met with, some coincident blood-change is to be found. Thus in the class of malarial diseases, masses of black material are formed in the blood (*melanæmia*), from destruction of the red corpuscles during the pyrexial state, and are liable to be deposited, it is said, by the white corpuscles, in certain organs, especially the spleen. In Addison's disease, purpura, syphilis, &c., characterised by pigmentation, the red corpuscles are obviously affected. The deposition of pigment appears without doubt to be somehow under the control of the sympathetic centres.

Dr. Laycock observes:—'Fundamentally the entire series of phenomena in which pigmentation is a leading characteristic, may be regarded as having reference to the excretion of carbon after it has served its purpose in the economy; and, pathologically, the production of pigments may be taken as the expression of—(*a*) imperfect oxidation of carbon, so that it is not eliminated as carbonic or lactic acids, &c.; (*b*) imperfect elimination of carbon proper; and (*c*) excessive production of carbon from highly carbonaceous foods. In all these there is a close analogy between the carbonaceous excreta as morbid pigments, and the nitrogenous excreta as morbid deposits of urates, &c.' However, all diseases in which the red corpuscles are altered, and their oxygen-carrying power diminished, tend to be associated with pigmentation, from imperfect oxidation of the carbon-waste.

A spurious pigmentation or blackish colouration by sulphide of iron is to be met with *post mortem*, or in gangrenous areas, from the union of sulphuretted hydrogen with the iron of the blood. W. H. Allchin.

**PILES.**—A popular name for hæmorrhoids. *See* Hæmorrhoids.

**PIMPLES.**—A popular name for papules. *See* Papula.

**PISA, in Central Italy.**—Rather moist, mild, equable, calm, and relaxing climate, Mean temperature, winter, 44° Fahr. East prevailing wind. *See* Climate, Treatment of Disease by.

**PITTING.**—The formation of pits or hollow cicatrices in the skin, resulting from ulceration, as in small-pox; or from disorganisation of tissue and absorption of the papillary layer of the skin, as in syphilis and lupus. Also, the depression produced by pressure on an œdematous part.

**PITUITOUS** (πήττω, I congeal).—A term associated with phlegm or expectoration, when this is of the nature of thick and adhesive mucus. *See* Expectoration.

**PITYRIASIS** (πίτυρον, bran).—Synon.: Furfur; Porrigo; Fr. *Pityriasis*; Ger. *Kleiengrind.*

Definition.—A branny exfoliation of the skin; giving rise to scurfiness or scaliness of the epidermis; and accompanied with heat, dryness, redness, and pruritus.

Ætiology.—The cause of pityriasis must be regarded as a feeble state of the skin, probably dependent on a low condition of the general system. In a symptomatic form, however, it may be due to the causes which control the parent disease, as in the case of eczema.

Anatomical Characters.—Pityriasis is a superficial chronic inflammation of the skin, without exudation or swelling, but especially characterised by disturbed nutrition of the epidermis and its desquamation in minute scales. Essentially it is a mild manifestation of eczema, and must be regarded as one of the forms of dry eczema.

Description.—The most common seat of pityriasis is the scalp—for example, *P. capitis*; and in that situation it may present several degrees of severity, ranging between the pityriasis with silvery scales of elderly persons (*xerasia*), or the mere accumulation of epidermic exuviæ in children and young persons, called 'dandruff,' and the more extensive desquamation, attended with chronic inflammation, of a declining eczema or even of psoriasis.

On the sensitive skin of children, particularly those of light complexion, it is apt to appear on the face in the form of small, circular, reddish discs, coated over with a fine furfur; and occasionally it is met with in patches on the body and limbs, and always maintaining the same characters, namely, heat, redness, and pruritus, but a total absence of serous exudation.

The term pityriasis, whilst strictly signifying an exfoliation of fine scales upon a skin which is more or less congested, yet falls short of the activity of eczema, has also been applied to a furfuraceous state of the skin accompanying other morbid affections of the texture; for example, *elephantiasis Græcorum*, and especially *xeroderma* in its transition to ichthyosis. Another form of exfoliation of the epidermis associated with a yellowish pigmentation of the skin, received from Willan the name of *pityriasis versicolor*; but as the pathological conditions of the latter are totally different from ordinary pityriasis, and are identical with the phytiform or so-called parasitic diseases, this affection will be found treated of under the head of Phytosis versicolor.

Diagnosis.—The description of the physical signs and the pathological condition of this affection will sufficiently distinguish it from other diseases; although, as will be perceived, it may be an accidental accompaniment of a variety of cutaneous affections, such as dry, chronic eczema. Indeed, its idiopathic form is its rarest manifestation.

Prognosis.—Taken by itself, pityriasis must be regarded as a trivial affection, and one which will speedily yield to appropriate treatment.

Treatment.—Our efforts in this direction should be aimed at the improvement of the nutritive function of the skin, and the relief of local inconvenience or suffering. The first indication is to be met by general tonics, and by the exhibition of small doses of some arsenical preparation; and the second by the application of the red oxide of mercury ointment in a diluted form (one part to three), or the oxide of zinc ointment. The former remedy is the more suitable for the scalp or hairy regions of the body; and the latter for the unprotected surface of the face and trunk. Erasmus Wilson.

**PITYRIASIS VERSICOLOR** (*πίτυρον*, bran, and *versicolor*, of changing colour).—A synonym for phytosis versicolor. *See* Phytosis Versicolor.

**PLACENTA, Diseases of.**—Synon.: Fr. *Maladies du Placenta*; Ger. *Krankheiten des Mutterkuchens.*—The frequency and importance of placental disease is hardly yet sufficiently recognised; and forty years ago, when the late Sir James Simpson published his memoir *On Congestion and Inflammation of the Placenta*, almost nothing was known on this subject.

The placenta being the sole medium of vital communication between the fœtus and mother, any deviation from its normal condition, by which its development may be arrested, and its physiological action impaired, must be of serious consequence.

The principal diseases to which the placenta is subject are:—1. Inflammation; 2. Congestion; 3. Hæmorrhage; 4. Hydatidinous degeneration; 5. Fatty degeneration; 6. Atrophy; 7. Hypertrophy; 8. Œdema; and 9. Calcareous deposits.

**1. Placenta, Inflammation of.**—Synon.: Placentitis.—Acute inflammation of the afterbirth is the sole cause of those morbid adhesions that occasion the most serious dangers of parturition, namely, *post-partum* hæmorrhage and inversion of the uterus. Moreover, it sometimes causes the death of the fœtus by destroying the structural integrity of the placenta. The disease is generally syphilitic in its origin.

Symptoms.—The symptoms of placentitis are so obscure that it is seldom detected until after the birth of the child, when we find the placenta adherent.

In many cases, however, this disease is attended by constitutional irritation or febrile disturbance of a remittent character. A very usual symptom of placentitis is the return of morning sickness in the later months of pregnancy, together with a dull aching pain, or a sensation of weight and fulness, over the hypogastric or iliac regions. The placental souffle will also be found intensified in sound, or abnormal in some other respect.

Treatment.—The treatment most in use for placentitis is a mild alterative course of mercury conjoined with tonics, and followed by iodide of potassium. Severe local pain may be relieved by leeching, or by the application of oleate of mercury with morphia, or by iodated liniments.

**2. Placenta, Congestion of.**—This condition is occasionally met with after a protracted labour, the placenta being then found engorged with blood, hard and tumefied, its external surface of a deep purple colour, and covered with a raised network of tortuous and congested vessels. Acute congestion, from the sudden engorgement of the placental vessels, may also arise at any period of pregnancy, from general plethora, or the recession of some acute inflammatory disease. It may also be occasioned by the sudden check to the placental circulation from the death of the embryo.

The *diagnosis* between congestion and inflammation of the placenta is impossible; and the *treatment* is the same in both cases.

**3. Placenta, Hæmorrhage into.**—Acute congestion of the placenta generally terminates by hæmorrhage into either the deciduous or cellular (maternal) portion; into the villous or vascular (fœtal) part of this organ; or in some cases into the cellular interspace between these, thus constituting what Cruveilhier described as 'apoplexy of the placenta.' Hæmorrhagic effusions of this kind are a frequent cause of miscarriage.

Occasionally, especially amongst the ill-treated wives of the labouring classes, placental hæmorrhage is the result of external violence or shock. The effusion then generally takes place from the central external surface of the placenta, which is thus partially separated from the uterus; but if the effusion be limited to a few ounces, gestation may go on undisturbed.

**4. Placenta, Hydatidinous Disease of.**—This consists in degeneration and abnormal development of the placental villi of the chorion, usually following, although occasionally producing, the death of the fœtus. In the *Dublin Obstetrical Transactions* for 1874–9, the writer has related several instances of this comparatively rare disease. In most of these cases the hydatidiform mass was expelled from the uterus at the fifth month. *See* Mole.

Symptoms.—The symptoms of this disease can at first hardly be distinguished from those of ordinary pregnancy. If, however, in addition to the signs that usually denote the death of the fœtus *in utero*, the patient experiences occasional gushes of water, together with slight hæmorrhage from the uterus, lasting for a short time, and recurring at irregular intervals, we may suspect the existence of hydatidiform disease in the placenta of a blighted fœtus.

The expulsion of these growths from the uterus is generally attended by severe hæmorrhage.

Treatment.—In the way of treatment, nothing can be done to arrest the progress of the disease, although chlorate of potash has been suggested for the purpose. But an attempt should

always be made to prevent its recurrence by improving the general health of the patient by alteratives and ferruginous tonics, especially any of the milder saline chalybeate waters, such as Ems, Kissingen, or Schwalbach.

It has been recommended that we should bring on the expulsion of hydatidiform moles as soon as they are discovered. This, however, is inadvisable. Only a portion of the placenta may be affected; or, as the writer has seen, the birth of a healthy living child may be immediately followed by the hydatidinous placenta of a blighted twin conception. Hence, we should let nature take her course, for in due time the morbid growth will be surely expelled from the uterus, rather than by unnecessary interference run the risk of destroying a living fœtus.

**5. Placenta, Fatty Degeneration of.**—This is a common disease. The late Sir James Simpson, Virchow, and Dr. Druitt, as well as some earlier writers, have discussed the nature of the affection, on which more light has been since thrown by Dr. Barnes's papers in the 34th and 36th volumes of the *Medico-Chirurgical Transactions*, and by Dr. Braxton Hicks' researches in the 14th volume of the *Obstetrical Transactions*. The symptoms and treatment of this condition are so obscure, however, that it will be unnecessary to dwell on it in the present work.

**6. Placenta, Atrophy of.**—Atrophy of the placenta is an occasional cause of the death of the fœtus between the sixth and ninth months of gestation. The uterine placental villi in such cases are arrested in their development, undergoing a retrograde metamorphosis into an opaque molecular substance, generally accompanied by fatty deposits in the umbilical terminal vessels of the fœtal portions of the blighted organ.

**7. Placenta, Hypertrophy of.**—This is a much more rare pathological condition than that last mentioned. We sometimes, however, find the placenta greatly enlarged without any other apparent alteration in its structure, and in such cases the child, if alive, is usually diminutive and puny, being stunted not only by the blood having been diverted from its nutrition, but still more by the compression of the terminal umbilical vessels.

**8. Placenta, Œdema of.**—Effusion of serum is another consequence of placentitis. In the few cases of this kind that the writer has seen, abortion occurred, and the placental villi were enormously distended and bloodless, being filled with a serous fluid. In one instance, in addition to the dropsy of the placenta, the umbilical cord was œdematous to an extraordinary extent.

**9. Placenta, Calcareous Deposits in.**—Calcareous deposits are sometimes met with in cases of adherent placenta, being usually situated in the external or uterine surface, and in the decidual vessels. In some instances, however, the writer has found these deposits scattered throughout the whole substance of the afterbirth.

THOS. MORE MADDEN.



**PLAGUE** (πληγή, *plaga*, a stroke).—SYNON.: The Pest; Inguinal, Bubonic, Glandular, Oriental, Indian, Pali, and Levantine Plague; Oriental Typhus; Septic Pestilence; Fr. *la Peste*; Ger. *die Pest*.

DEFINITION.—A specific fever, attended by bubo of the inguinal or other glands, and occasionally by carbuncles.

HISTORY.—The term *plague* is used by the older historians in two senses, (1) in a general sense, as applicable to the prevalence of diseases accompanied by great mortality, irrespective of their nature; and (2) in a limited sense, as indicating the particular malady defined above. The earliest notice of the disease now designated *plague* is found in a work of Oribasius, the physician to the Emperor Julian (A.D. 361-363). He quotes from Rufus (Alexander) of Ephesus, a writer who lived in the reign of the Emperor Trajan (A.D. 98–117), a passage from which it would appear that plague had been known as an endemic, and occasionally as an epidemic, in Libya (North Africa), Egypt, and Syria, from the end of the third or beginning of the second century before Christ. The first appearance of plague in Europe is referred to the 6th century of the Christian era. In the reign of the Emperor Justinian (A.D. 527–565) the disease underwent a development previously unknown. According to contemporary historians, it broke out in Egypt, explosively, and presently spread thence to the neighbouring countries of Africa and Asia; invaded and extended over the whole of Europe; and generally became disseminated throughout the then known world, causing frightful mortality wherever it showed itself. From this period, it is inferred, plague became established in Europe, being sometimes more, sometimes less prevalent, for the 1,300 years following—indeed, until the ninth lustrum of the present century.

The great pestilence, most familiarly known as the *black-death*, which swept over the western hemisphere in the 14th century, causing an inconceivable mortality, and which has been designated *black plague*, although presenting several of the symptoms of bubonic plague, is held by some epidemiologists to have differed essentially from that disease. The *black-death*, according to these writers, was particularly characterised by a gangrenous inflammation of the respiratory organs, violent fixed pains in the chest, vomiting and spitting of blood, and a horribly offensive and pestiferous breath, which could be perceived at a considerable distance from the patient. Such symptoms distinguished, these writers think, the disease from bubonic plague. Moreover, it is noted that while bubonic plague had had its apparent source in Egypt seven centuries before, black-death, according to contemporary writers, had its origin in Cathay (Northern China), and issued thence to devastate the world. Writers who regard black-death as a different malady from plague, hold that the pestilential manifestation of the disease began and ended with the dreadful outbreak of the 14th century, and that the malady has long been extinct.

Other writers consider black-death to have been a modification of bubonic plague. But if this view be accepted, the extraordinary development and remarkable modification which the dis-

ease underwent in the 14th century, stand quite alone in the history of the affection, and constitute phenomena which would have to be regarded as indicative of a secular evolution of morbid changes (*see* PERIODICITY IN DISEASE). This last-named view of the relation between black-death and bubonic plague is not without a present interest. For Hirsch and others believe that the *Máhámari* of Northern India—the *Pali*, or *Indian plague*, as the disease is also termed—which has several times prevailed as a local epidemic since the commencement of the present century, is a disease analogous to the *black-death* of the 14th century. Probably these writers would now include the more recently known *Yunnan plague* in the same category.

In the 15th century the countries in which plague was habitually present or recurred at intervals, included Northern Africa, Egypt, Western Arabia, Syria and Palestine, Asia Minor and Mesopotamia, Persia, probably India and China, and Europe generally. Throughout the 16th and 17th centuries there are almost continuous records, from year to year, of the presence of the disease, in greater or less activity, within this area of prevalence (Carl Martin, *Petermann's Mittheilungen*, Juli, 1879). During the latter half of the 17th century a remarkable lessening of the area of prevalence of the disease began to take place. As regards Europe, in the course of the twenty years 1661–1681 plague disappeared from Italy, England, Western Germany, Switzerland, the Netherlands, and Spain. This lessening of area continued throughout the 18th century, the number of serious outbreaks of plague also diminishing, two only having occurred in that century, namely, (1) in 1703–13, (involving Turkey, Hungary, Russia, Poland, Austria, Bohemia, and Eastern Germany), and (2) in 1720–22 (Provence). At the close of the first third of the 19th century, the area of prevalence of the disease had shrunk to the easternmost part of the Turkish Empire in Europe; and in the year 1841 plague ceased on the Continent altogether.

While this change had been taking place in Europe, a corresponding change had been manifested in the prevalence of the disease in its habitats elsewhere. Before its complete cessation in Europe, plague would appear to have disappeared from Northern Africa (except Egypt), from Mesopotamia, and from Persia; the existence of the disease in Asia Minor, Syria, and Palestine came to an end in 1843; and in the year 1844, with the cessation of the malady in Egypt, plague seemed to have become wholly extinct, and Europe to have got rid of a terror which had harassed it for ages.

It is noteworthy that during the period of the progressive narrowing of the limits within which plague prevailed, and until its disappearance, the disease manifested no abatement of those characteristics, as well in respect to rapidity of course, to the nature of the symptoms, and to its fatality, which had made it the dread of Europe and the Levant. The outbreak of 1665 in London, which preceded the disappearance of the disease from England, and which is known as *The Great Plague of London*; also the outbreak of 1720 in Marseilles, which preceded the disappearance of the disease from France, have become historical from the fatality which accompanied them. Hardly, if at all, less terrible was the outbreak in Moscow in 1770, and the later outbreaks in Turkey, in Syria, and in Egypt. Even at the present day the traveller in Persia and Kurdistan comes upon communities the growth of which has been arrested, and the ruins of villages which have been depopulated, by the ravages of plague earlier in the century.

Notwithstanding the disappearance of plague from its last-frequented haunts, certain epidemiologists, and notably Gavin Milroy in this country, having regard to the long intervals which had occasionally been observed between recurring epidemics of the disease, doubted its cessation. Their doubts were presently confirmed by the re-appearance of the plague in the Levant. This happened in 1853 (nine years after the presumed cessation of the disease in Egypt) in the Assyr country, Western Arabia, where a circumscribed outbreak occurred. Other local outbreaks followed at intervals in different places, in the order and countries here noted:—

1853, the Assyr district, Yemen, Western Arabia; 1858–59, province of Bengazi, Regency of Tripoli, North Africa; 1863, district of Maku, Persian Kurdistan; 1867, the marsh district on the right bank of the Euphrates, south and west of Hillah; 1870–71, Persian Kurdistan, in the district south-east of Lake Urumiah; 1871–73, Yunnan province, Western China; 1873–74, the marsh district on the left bank of the Euphrates, south of Hillah and the position of ancient Babylon. This outbreak proved to be the beginning of a manifestation of the disease, which in the course of the years 1874–75, 1875–76, and 1876–77, showed itself over an area extending from Bagdad on the north, to Suk-e-Sheyukh on the south, and from the banks of the Tigris and Shat-el-Hai on the East to the borders of the Syrian desert on the west. Hillah suffered from this outbreak in 1876 (recorded deaths 1,007), and Bagdad, both in 1876 (recorded deaths 2,611) and 1877 (recorded deaths 1,672). The outbreak of 1873–74 on the Lower Euphrates was not the only appearance of plague at that period. Two other outbreaks occurred in 1874, one in the Assyr district, Western Arabia (the scene of the outbreak of 1853), and another in the province of Bengazi, Regency of Tripoli (the scene of the outbreak of 1858–59). In 1876, in addition to the then prevalence of the disease in the district south of Bagdad and on the Lower Euphrates, plague broke out in the Shuster-Dizful district, Khuzistan, south-eastern Persia; and before the close of the year it had shown itself also in two villages of northern Persia, situated about twenty-five leagues from the south-eastern angle of the Caspian Sea. The same year also there was an outbreak of *Máhámari*, in the mountainous district of Kumaun, North-western India, which did not terminate until the following year. In 1877 an outbreak occurred at Resht, the capital of the province of Ghilan, Persia, and in the surrounding district. Ghilan lies at the south-west angle of the Caspian Sea. The same year cases of a fatal bubonic febrile malady occurred in the district of Baku, on the Caspian shore of Transcaucasia; and an

outbreak of a non-fatal bubonic affection took place in Astrakhan and its vicinage, since recognised as a form of plague. At the beginning of 1878 plague was reported in the district of Souj-Bulak, Persian Kurdistan; and in October the disease broke out at Vetlianka, a Cossack settlement on the Lower Volga, in the province of Astrakhan, Russia in Europe, and prevailed there and in the adjacent districts on both banks of the river, until February, 1879, with the exception of an isolated case, or more than one, which was observed in the following month.

Since this outbreak, when, after thirty-seven years' absence, plague re-appeared on European soil, the disease has shown itself again (February–June 1879) in the Assyr district, Western Arabia, and there have been doubtful rumours of its presence in Persian Kurdistan.

Ætiology.—Plague is observed to be developed under two principal sets of conditions, namely, (*a*) certain *local states*, physical or social, or both, as the case may be, affecting communities; and (*b*) certain *relations between persons* sick of the disease and healthy persons. To these must be added (*c*) particular *seasonal influences*.

(*a*) The *local conditions* which favour the development of plague were made the subject of careful study by a commission of the French Academy of Medicine, in 1844. The report of this commission, prepared by Prus, sums up and represents the then existing knowledge on the subject. According to the commission, plague was a product of Egypt (where it was held to be endemic), Syria, the two Turkeys (Turkey in Europe and Turkey in Asia), and many other countries of Asia, Africa, and Europe; and the conditions 'which determined and favoured' the development (birth of the disease among communities there, were:—dwelling upon alluvial and marshy soils, notably such as were found near the shores of the Mediterranean, and on the banks of certain great rivers, the Nile, the Euphrates, and the Danube being specified; a warm and humid atmosphere; low, badly ventilated and crowded houses; great accumulations of putrefying animal and vegetable matters in the vicinity of dwellings; unwholesome and insufficient food; excessive physical and moral misery; and neglect of the laws of health, as well public as private.

The recent appearances of plague have served to correct some, and to confirm others of these conclusions of the commission. Plague is no longer endemic in Egypt; but of late years, as already stated, it has broken out in several widely separated places of Africa and Asia. In these outbreaks (excluding from consideration for the present the outbreak in Astrakhan province), the disease appears to have been a local product determined by as yet entirely unknown conditions. The term 'spontaneous' is frequently applied to such developments of disease, but is best avoided as implying more than is warranted by our present knowledge. Again, the recent outbreaks have shown (and Tholozan has particularly dwelt on this subject) that plague is, perhaps, as much a disease of the highlands as the lowlands. This is evidenced by its persistence, in Kumaun, on the Himalayan mountains, and among the mountains in Western Arabia and in Yunnan. The outbreaks in Persian Kurdistan in 1870–71, and in the province of Bengazi in 1873-74, took place on elevated tablelands. The outbreaks also of 1853 and 1874 in Western Arabia took place among the highlands. But, if a less restricted topography must be assigned wherein plague may manifest itself as a local product, so to speak, the later prevalences of the disease confirm fully the conclusions of the Commission of 1844 regarding other conditions of development which are not peculiar to any country or locality. The outbreak of 1858–59 in the province of Bengazi followed upon four years' drought and failure of crops, at a time when the greater part of the flocks and herds had been destroyed from want of food, and by a fatal epizootic which prevailed among them, plague breaking out when the population was suffering most from famine, and when the physical and social misery resulting from destitution was greatest. The same was, in effect, the state of things when plague appeared in Maku, in Persian Kurdistan, in 1863; but here it is noted also that the infected district was pervaded with the putrid emanations from the unburied bodies of cattle which had died from murrain. The outbreak of 1867 on the Lower Euphrates was confined to marsh-villages on the right bank of the river; and that of 1873-74, in the same district (the beginning of the greater development of 1874–77), began in marsh-villages on the left bank of the river. The huts of the particular class of villages affected, writes W. H. Colvill, 'are on ground which is a foot or two lower than the surface of the water in spring; and the ground is so saturated with water, that the refuse of the village is neither absorbed nor can it be evaporated, for it acquires fresh moisture from the ground, and this refuse acquires the form of a bluish-black oily fluid which surrounds the huts and covers the paths, and stains the walls two feet from the ground; and, in fact, the village is in such a state of filth that it requires to be seen to be believed.' The outbreaks of 1867 and 1873–74 had been preceded, according to Colvill, by the only two great inundations of the Euphrates which had occurred since 1831, the year of the then latest outbreak of plague in Bagdad. The outbreak of 1870–71 among the highlands of Persian Kurdistan, had been preceded by a fatal epizootic among sheep, and ergotism among the people. Writing of one of these mountain-villages—and the account serves for all—Castaldi says: 'Whatever is most afflicting in poverty, whatever is most revolting in filthiness, is accumulated, as if designedly, around these infected dens, in the interior of which live, or rather vegetate, from fifty to sixty men, women, and children. The cultivation of some plots of ground in the neighbourhood furnishes these unfortunates with insufficient nourishment.' The infected district escaped the famine which at this time prevailed in Persia, but it may be a question if the inhabitants escaped severe privation during the winter in which plague first appeared. The outbreak of 1874, in the province of Bengazi, North Africa, occurred among the nomadic tribes occupying the Cyrenaic plateau at a time when some of the favourite Arab camping-

grounds had been converted into vast swamps from heavy and protracted rains, and when the people were reduced to the most abject misery and were suffering from an extremity of famine, the result of failure of their crops for three years in succession, consequent on drought. The outbreak of 1876–77 in the mountain-villages of Kumaun took place among communities who are described as occupying houses in which cattle, grain, and families are packed together under conditions of filth not unlike those observed in the mountain-villages of Kurdistan. Of the conditions under which plague was observed in the great towns, as in Bagdad and in Resht, as also on the Volga, they were states of filth, in and about dwellings, such as might be anticipated where no organised scavenging had ever existed, and of crowded and badly-ventilated houses. But in Bagdad and the Mesopotamian towns generally, the most influential condition in promoting plague was, according to Colvill and Cabiadis, *poverty*. Cabiadis, indeed, styles the disease, *miseriæ morbus*, thus reproducing, in 1878, a name by which plague was designated by some in the 'Great Visitation' of London, 1665, namely, 'the *Poor's Plague*.' On the other hand, the communities which suffered on the Volga were prosperous and believed to have plenty (on somewhat doubtful evidence, it must be confessed); but at the time of the appearance of plague among them, they were living under almost indescribable conditions of filth accumulated about their houses, and from which the interiors were not free.

The local conditions which have been observed to be favourable to the development of plague since the reappearance of the disease in 1853, it will thus be seen, are similar to those which were observed before its disappearance from Europe and the Levant in 1844.

(*b*) That the kind of *relations maintained between persons* sick of plague and the healthy exercised an important influence upon the propagation of the disease, has been made clearly manifest in the recent outbreaks. The more closely and continuously the healthy were brought into association with the sick, the more certain were the former to suffer from the disease. Thus persons living in the same house with the patient were peculiarly liable to suffer, while those who were brought only occasionally into contact with him (as the physician) were rarely affected. And here, again, a difference was noted between the liability of the physicians and of the surgeons and their assistants to be attacked by the disease, the duties of the latter calling for more frequent and protracted visits to the patients than the duties of the former, and they suffered to a greater extent. No doubt was entertained that the disease was, in ordinary phrase, *caught* from the sick by the healthy brought into association with them; but there was no certain evidence that actual *contact* with the sick person was necessary to the transmission, as the older doctrine of contagion maintained. On the contrary, the evidence indicated that the transmission was chiefly effected through the healthy breathing the same atmosphere as the sick, that is to say, the atmosphere surrounding the sick person. There would appear to be, in addition, evidence of transmission of the malady by the agency of *clothes and bedding* which had been used by the sick. The newer information obtained on this subject of the transmissibility of plague from those sick of the disease to the healthy, corresponds with the results obtained on the same subject by the commission of the French Academy in 1844, and both point to a close analogy between the modes of transmission of plague and of typhus, and between the habits of the two infections. In plague, as in typhus, the liability of the healthy to contract the disease is mainly dependent on the constancy and intimacy of communication with the sick. In plague, as in typhus, the danger of infection appears to be principally proportionate to the fouling of the atmosphere surrounding the sick by the effluvium from his body and breath; and in like manner either infection would seem to be peculiarly easy of destruction by free dilution with air. Again, there seems to be no trustworthy evidence to show that the danger of the propagation of plague by *fomites* (as the older writers have it), that is to say, by articles carrying the infection of the disease—such as clothing and bedding—is greater in plague than in typhus. The condition for infection of articles of clothing and bedding was their very intimate use by, or association with, the sick. Evidence was entirely wanting of articles other than those mentioned, and under other conditions, being capable of communicating the disease to the healthy; nor was there anything to confirm the assumption that the long array of articles contained in quarantine-regulations regarding plague were capable of retaining and conveying the infection.

(*c*) Both the sets of conditions here noted as affecting the development of plague appear to be influenced by *seasonal* changes. In Mesopotamia the disease, during its prevalence there, rapidly declines, and becomes dormant, with the setting-in of the hot weather in June (beginning to fall when the temperature reaches 86° F., and ceasing abruptly at 113° F.), its activity re-awakening in winter, and gathering force with the advancing spring. Similar phenomena were observed in Egypt, whilst the disease prevailed in that country. In Constantinople, on the contrary, the disease was dormant during the colder months of the year, and became active during the hotter. The same was true of this country when the disease existed here, as is particularly observed in the season of prevalence of the epidemics which have ravaged the metropolis. Here, as Wm. Farr, Ed. Smith, and, more recently, Buchan and Mitchell have shown, from the records of mortality, September was the month of greatest prevalence, the disease rising throughout July and August and falling throughout October and November. Further north (in Moscow, for example) the disease has prevailed as severely in the depth of winter as in the height of summer.

Incubation.—The recent outbreaks have not furnished much additional information on this subject, but, such as it is, it tends to confirm the conclusion of the commission of the French Academy. This was to the effect that the disease had never shown itself among compromised persons after an isolation of eight days. L. Arnaud carefully studied the question in the outbreak of

1874, in the province of Bengazi, and from the facts he then collected concluded that the mean time of incubation of plague was five or six days, and that the maximum duration did not exceed eight days. Hirsch, from the information he obtained at Vetlianka, relating to the recent outbreak in the province of Astrakhan, concluded that the minimum period of incubation observed there was from two to three days, the maximum exceeding eight days, and that the average might be set down at five days. He notes, however, that very short or very long periods of incubation were seldom observed.

Symptoms.—These are summarised here wholly from the writings of recent observers: W. H. Colvill and Giovanni Cabiadis (as made known by E. D. Dickson) in regard to plague in Mesopotamia; Castaldi, in regard to plague in Mesopotamia, Persian Kurdistan, and Resht; L. Arnaud, in regard to plague in Bengazi (*see* Blue Book, 'Plague,' 1879); Döppner (official report); Hirsch (*Practitioner*, ii. 1879); and W. H. Colvill and Payne (official report), in regard to plague in the province of Astrakhan. This course is taken, first, because the disease, as they describe it, is that which the present generation is called upon to consider; and, secondly, because, generally speaking, the symptoms observed by them are similar to those described by the earlier writers on the subject.

Plague occurred in three forms in the recent outbreaks, namely (1), an *abortive* or *larval*; (2), a *grave* (*plague*, as usually understood); and (3), a *fulminant* form.

1. **Abortive (larval) Plague.**—This form is characterised by the appearance of buboes in the groins, armpits, and neck, as a rule painless, and unaccompanied by feverishness. At times, but rarely, the manifestation of the buboes is preceded and accompanied by a general febrile disturbance of the system, so slight as not to preclude the patient from moving about (*ambulatory plague*). At times also, a bubo suppurates; but more commonly these swellings disperse in about fourteen days. The buboes are clearly distinguishable from the chronic glandular swellings observed in persons of a scrofulous tendency, or affected with any special diathesis. Cases of abortive plague were recorded in the greater number of the recent outbreaks of the disease of which we have detailed accounts, and were particularly observed preceding and following the outbreak in Mesopotamia in 1873–77, and preceding the outbreak in the province of Astrakhan in 1878–79. It is questionable whether this form of the disease, unaccompanied by any marked febrile disturbance, is infectious.

2. **Plague in its usual form.**—The onset and progress of plague differ much in different cases, and at different periods of an epidemic. Most frequently, after a brief time of lassitude, aching in the limbs and loins (sometimes a very painful aching), and shiverings, a febrile state commences; and concurrently with this, or from the second to the fourth day of its duration, buboes appear in the groins, the armpits, or beneath the angle of the jaw. The febrile state is usually acute, and accompanied with much, often severe, headache, and delirium or stupor; the face being flushed; the eyes red and turbid; the skin hot; the tongue black, dry and fissured, or coated as with cotton wool, or pointed at the tip, with red edges and thickly furred in the centre; the teeth and gums covered with sordes; and the thirst intense. The swelling of the glands increases, and is accompanied by much, sometimes acute pain; and if the patient have lived on, suppuration may take place about the seventh day, at which time, if not earlier, carbuncles or boils may appear. Of these symptoms, or groups of symptoms, it may be noted more particularly, that the disease is sometimes ushered in by vertigo, or convulsive tremor, or a peculiar, absent, 'lost' state, when the patient, if he be seized from home, will be observed to make his way thither in a quasi-automatic fashion, with a strange staggering gait; or else the patient, whilst going about his ordinary avocations, is seen to become distracted, as if impressed with some indefinable fear, which prompts him, if away from his house, to rush wildly through the streets until he reaches it, and then throw himself on the bed in a state of extreme restlessness; while, in the gravest cases, the patient is attacked at the same period with vomiting of blood and a high febrile state. Cabiadis describes cases ushered in by a *prolonged regular shake*, which persists from six hours to three days, the temperature of the body remaining nearly normal, and the patient not complaining of cold. This *shake* was invariably followed by coma, during which the patient sank rapidly. The pulse, in the febrile state, runs quickly up to 100–130; and the temperature of the body to 102–104°, and in the acutest cases to 107·6° Fahr. The end of the febrile state is marked by a sudden fall of temperature, the thermometer descending sometimes as low as 93·2° Fahr.; at the same time a profuse perspiration often occurs. Heat in the throat and in the epigastrium (in the latter, as of burning charcoal there) was a not unfrequent complaint of the patients; and at times a sensation likened to being stabbed by a knife in the breast has occurred. Nausea and vomiting of bilious matters were not uncommon (Arnaud); and vomiting of coffee-ground-looking matter was frequent at the beginning of the outbreak of 1873–74 on the river Euphrates. Constipation is the rule in the acute stages of the disease. It is sometimes followed by diarrhœa, which has been regarded as a favourable sign. No noteworthy change appears to have been observed in the urine, either as to general appearance or quantity, unless it were mingled with blood; but Döppner describes its diminution and even suppression in severe cases at Vetlianka. *Hæmorrhages* were observed from the nose, the lungs, the stomach, the bowels, the vagina, and the urethra; and the cases in which they occurred all ended fatally. Occasionally the respiration is much hurried, but Arnaud states that such disturbances of the respiration as he witnessed in Bengazi were of nervous origin—a nervous dyspnœa preceding death. The prostration is extreme in some cases, and in a few instances in which this was observed consciousness was maintained until just before the patient expired.

Of the *local signs*, the appearance of the *buboes*

not unfrequently precedes the symptoms of general disturbance. In some cases they are first observed within seven or eight hours after the febrile state has set in; in other and more numerous cases they show themselves on the second, third, and fourth days of the attack, and rarely on the fifth. When the buboes appear first they are sometimes accidentally discovered, the patient having no previous suspicion that he is affected; but more generally their appearance is preceded by pain in the glandular organs, at times sudden in accession, the patient exclaiming he has been stabbed in the groin, armpit, or elsewhere, as the case might be. The enlarged glands forming buboes are rarely numerous, and of a group only one is, as a rule, conspicuously enlarged, sometimes attaining a size equal to a turkey's egg or an orange, while the others are but little enlarged. The swelling at times is very rapid. Suppuration is not often observed in the fatal cases, and so it happened that suppuration came to be regarded by the inhabitants of the localities where plague prevailed as a favourable sign; while on the other hand, 'flattening' or subsidence of the swollen glands in the early days of attack was held as indicative of a fatal result. *Boils* and *carbuncles* occur, but not very frequently. *Petechiæ* are often observed, most usually preceding a fatal issue; at times occurring comparatively early in the progress of the disease. Sometimes they are distributed generally over the body, at other times they are chiefly localised in the vicinity of the enlarged glands. They vary in size from the dimensions of a grain of millet to those of a lentil. They are at times so numerous that the skin assumes a livid hue, and the corpse has a blackened appearance after death. This appearance is so characteristic of the disease, says Cabiadis, that the malady might properly have been called, even in this day, *black-death*.

The plague has a special *physiognomy*, having nothing in common with either typhus or pernicious fever in any of its forms, or with relapsing fever. 'The eyes are retracted within the orbits, but not surrounded with the blue circle which is seen in cholera; the aspect is haggard, but without the fixity seen in typhous cases; the facial muscles are relaxed as other muscles of the patient, and do not present the wrinkles and contractions observed in a patient attacked with typhus or cerebral maladies; the countenance of the plague-stricken expresses apathy' (Castaldi). 'On coming up to a patient suffering from an attack of pernicious fever, you are struck with the gravity of his case and the danger threatening his life. The very reverse of this meets your eye when you see for the first time a case of plague. Even the worst instances of this malady are apt to deceive an inexperienced physician, and make him fancy that the case is free from danger, when in reality the patient has only a few hours to live. The first instance of plague seen by Dr. Cabiadis did not seem to him to be one of an alarming nature. The patient looked stupified, as if intoxicated, and did not answer readily the questions put to him. He vomited blood, and had a small bubo in the right axilla, but the pulse and temperature were normal. The patient died a few hours after Dr. Cabiadis' visit' (E. D. Dickson).

3. **Fulminant Plague.**—Cases to which this term is applied have been observed more particularly at the commencement of plague epidemics, but also during their course and towards their termination. These were cases which were struck down suddenly with illness and died in a few hours, without any of the characteristic indications of the disease—buboes and carbuncles, for example—having shown themselves. The conclusion that they were part of the prevailing epidemic—the infection having overwhelmed at once, as it were, the sufferers—appears justified by the prevalence, at the same time, of an intermediate class of cases, also very quickly ending in death, in which some traces of glandular swellings were observed, with profound disturbance of the nervous centres, convulsion or coma, and rapid formation of vibices and purpuric spots. The cases of the fulminant class which occurred at the beginning of the outbreak on the Lower Euphrates, 1873–74, were chiefly marked by vomiting of blood and setting in of a high febrile state concurrently. The natives had named these cases 'black-vomit' before the actual nature of the disease became apparent (Castaldi).

*Máhámari* (Pali or Indian plague); *Yunnan Plague.*—The recent descriptions of these forms of plague by Planck, Francis, Rocher, and Baber, do not present any such differences in the character of the disease as above described as to call for a separate account.

The Plague on the Volga, 1878–79.—Only one account of this outbreak has come into the hands of the writer from the pen of an actual observer, and it merits a separate notice. It is contained in a report of Dr. Döppner, principal medical officer of the Cossack troops in the province of Astrakhan at the time, and is founded on personal observation of twenty-three cases seen by him when the outbreak was approaching its greatest intensity. His description of the symptoms presents them as forming two groups:—1. Violent headache (forehead and temples), pains in the limbs, slight shivering, followed by high fever, pulse from 100 to 120, sense of burning in the body and eyes, distension of the abdomen, and enlargement of the liver. These symptoms lasted two or three days, and were in favourable cases followed by perspiration and recovery with general debility; but in the greater number, after an interval of two or three days, the fever returned, accompanied by delirium, sleeplessness, restlessness, a temperature of 107·6° Fahr., dryness of tongue, frequent involuntary dejections, urine scanty and reddish. Death usually occurred in the second paroxysm (sometimes, but rarely, after a third) preceded by convulsions and a general prostration of the vital powers.—2. In other cases the patient was attacked suddenly with palpitation of the heart, irregularity of pulse, vomiting, vertigo, oppression of the chest, spitting of clear blood, pallor, an apathetic expression, with dulled eyes and dilated pupils. The patient then remained for two or three hours in a state of extreme feebleness, followed by violent feverishness and delirium, suppression of the urine, and constipation. Maculæ appeared upon the body;

it exhaled a peculiar odour, something like that of honey; and death supervened in a state of lethargy, with complete prostration of the vital powers.

In neither form of the disease, at this stage of the outbreak, were buboes a conspicuous symptom, and in the latter form they were rarely observed; but buboes (inguinal and other) had characterised a series of non-fatal cases of abortive plague which had preceded the cases described, and during the decline of the outbreak buboes were again observed. Death in the cases described occurred in from twelve hours to three days. Decomposition of the body always set in rapidly.

[Dr. Z. Petresco, of Bucharest, who, under instructions from the Roumanian Government, visited the seat of plague on the Volga, and reached the infected locality early in February 1879, received accounts of the disease from physicians who had witnessed it at Vetlianka subsequent to the period of time to which Dr. Döppner refers (November 17 (29) to December 4 (16) 1878). He states that the predominant symptoms were intense headache, an acute febrile state (very rarely accompanied by delirium), and excessive prostration of vital force—these symptoms forming a 'triade séméiotique pathognomonique de la peste.' He also states that, at the beginning of the outbreak at Vetlianka, cerebral and lymphatico-glandular disturbances were chiefly noted, the latter manifested by submaxillary, axillary, and inguinal buboes; afterwards, at the height of the epidemic, graver indications of disorder of the nervous centres were observed, manifested especially by the headache, vertigo, feverishness, and collapse, the cases at times ending fatally in twelve hours; lastly, during the decline of the epidemic pulmonary disturbance predominated (hæmoptysis with symptoms of catarrhal pneumonia), inducing the medical men to diagnose the malady at this time as a croupal pneumonia, pneumotyphus, or malignant typhus.—February 1880.]

Diagnosis.—'No other idiopathic fever, attacking a multitude of persons at the same time, is characterised by glandular swellings, by carbuncles, and by those severe manifestations of the nervous, sanguineous, and biliary systems which declare themselves in an attack of plague.' —(Cabiadis, according to E. D. Dickson.) As regards *pernicious fever*, with which the disease was confounded by some medical men in Mesopotamia, Cabiadis says no *intermission* has ever been observed in plague; no attack of plague has ever been cut short by the administration of *sulphate of quinine*; and the *expression of countenance* (see above), and *general aspect* of a plague patient are strikingly different from those of a patient affected with pernicious fever. At Vetlianka, intermissions, according to Döppner, were observed.

Prognosis.—'Rapid suppuration of the buboes, even when accompanied with high fever, indicates a favourable termination; all cases complicated with nervous, hæmorrhagic, or bilious manifestations end fatally' (Cabiadis). Colvill is of opinion that the occurrence of diarrhœa in the course of plague, as seen in Mesopotamia, was a favourable sign.

Relapses and Second Attacks. — Arnaud notes both relapses and second attacks in his account of the Bengazi outbreak, 1873–74.

Age, Duration, &c.—Cabiadis and Colvill made an analysis of numerous cases of plague which came under their observation, from which the following particulars are taken in illustration of the foregoing symptoms, and as elucidating other questions.

*Age.*—Dr. Cabiadis noted the ages of 1,826 cases of plague observed at Hillah, in 1876, with the following result:—

| | |
|---|---|
| From 2 months to 9 years . . | 277 |
| „ 10 years to 19 „ . . | 617 |
| „ 20 „ 29 „ . . | 432 |
| „ 30 „ 39 „ . . | 292 |
| „ 40 „ 49 „ . . | 123 |
| „ 50 „ 59 „ . . | 52 |
| „ 60 „ 69 „ . . | 18 |
| „ 70 „ 79 „ . . | 11 |
| „ 80 „ 89 „ . . | 3 |
| An old man of 113(?)„ . . | 1 |
| Total . . . . | 1,826 |

*Buboes and Carbuncles.*

| | Cabiadis 1,826 cases | Colvill 402 cases |
|---|---|---|
| *Buboes*:— | | |
| In the Groin . . . | 710 „ | 128 „ |
| „ Axilla . . | 466 „ | 109 „ |
| „ Neck . . . | 98 „ | 19 „ |
| „ Crural region | — „ | 2 „ |
| „ Several places | 122 „ | 8 „ |
| „ not recorded . | — „ | 9 „ |
| *Carbuncles* . . . . . | 36 „ | 9 „ |

*Other manifestations.*—Cabiadis, with respect to the 1,826 cases mentioned above, gives the following numerical statement of the numbers in which noteworthy special symptoms were observed:—

| | | |
|---|---|---|
| Dependent on the nervous centres | Coma in . . . | 28 |
| | Convulsive shake | 9 |
| Dependent on the circulatory system. | Petechiæ . . . | 120 |
| | Epistaxis . . . | 2 |
| | Hæmoptysis . . | 6 |
| | Hæmatemesis. . | 27 |
| | Sanguineous diarrhœa . . . . | 14 |
| | Menorrhagia . . | 2 |
| Dependent on the assimilative organs. | Bilious vomiting . | 32 |
| | Bilious diarrhœa . | 16 |
| | Jaundice . . . | 2 |

*Duration.*—Colvill shows the duration of 534 fatal cases of plague as follows:—

| Days after attack | Number of Deaths |
|---|---|
| One day . . . . | 126 |
| Two days . . . . | 80 |
| Three „ . . . . | 105 |
| Four „ . . . . | 76 |
| Five „ . . . . | 60 |
| Six „ . . . . | 26 |
| Seven „ . . . . | 12 |
| Eight „ . . . . | 14 |
| Ten „ . . . . | 14 |
| Twelve days . . . | 9 |
| Sixteen „ . . . | 1 |
| Twenty „ . . . | 11 |

Mortality.—The mortality appears to have differed much in different places and at different periods of an epidemic. Colvill states, of the outbreak of 1874-75 in Mesopotamia, that the mortality in the first half of the epidemic in a village, was from 93 to 95 per cent. of those attacked, but that during the latter half of the epidemic the greater number of the attacked recovered. The mortality in Bagdad throughout the outbreak in 1876 was, he states, 55·7 per cent. of the attacks (cases 4,585, deaths 2,556). Arnaud gives the mortality during the outbreak in Bengazi, 1874, at 39 per cent. of the attacks (cases 533, deaths 208). According to Cabiadis, the mortality at Hillah in 1876 was 52·6 per cent. of the attacks (cases 1,826, deaths 961). Hirsch estimates the mortality at Vetlianka, on the Volga (Astrakhan) at 82 per cent of the attacks (cases 439, deaths 358); and Döppner states that at one period of the outbreak there was a mortality of 100 per cent. (in other words all who were then attacked died), and at another, and later period, of 43 per cent.

Anatomical Characters.—The recent outbreaks of plague have added nothing to our knowledge of the anatomical characters of the disease. The outbreaks occurred under circumstances where anatomical investigation was out of the question. The information existing on this subject was obtained almost solely at the time of the French expedition into Egypt at the close of the last century and the beginning of the present; during the outbreaks of plague in Bessarabia, 1825, and in Moldavia and Wallachia (1828-29); and again in the outbreak of 1834-35 in Egypt. The morbid alterations noted were ecchymoses of the coverings of the nervous centres, of the pericardium, the omentum, and the peritoneum; enlargement and softening of the spleen; punctated extravasations of blood in the mucous membrane of the stomach; ecchymotic spots in the mucous membrane of the intestines; reddish-black injection of the mesenteric glands; extravasation of blood—sometimes considerable—into the cellular tissue about the kidneys, the kidneys themselves being tumefied and presenting extravasation of blood in their tissue and in their pelves. The most constant and characteristic changes were observed in the lymphatic glands. When buboes had been formed, the glands presented manifest signs of inflammatory action in various degrees, as also at times the surrounding cellular tissue, which was, moreover, frequently the seat of bloody extravasations. The glands of the several cavities were more or less involved in or partook of the morbid action conspicuously observed in the buboes; and even where no buboes had formed, indications of considerable changes were found in the internal lymphatic glands. In some instances the affection of the glands would appear to have been general throughout the body; in others it would be limited to one or more of certain groups, in addition to the more superficial groups, as the bronchial, the mediastinal, the mesenteric, the lumbar, &c. The glands, as a rule, were found more or less enlarged, injected, and infiltrated with sanguineous fluid.

Treatment.—(*a*) *Curative.*—The recent outbreaks of plague have thrown no positive light upon its curative treatment. In Bagdad and Hillah the plan of treatment mainly followed was the internal administration of carbolic acid or of quinine, and the use of leeches and mercurial frictions to the buboes before suppuration. In some instances this plan was thought to have done good, in others it was useless, if not detrimental. In regard to plague, as to other grave general maladies, except those arising from paludal poisoning, curative treatment is at present only possible on general principles, both as regards the systemic and the local symptoms. The practice would appear to be the same in respect to the general symptoms as would guide the physician in the treatment of *typhus*; in respect to the local symptoms, such as would apply to ordinary phlegmon.—(*β*) *Hygienic.*—In the present state of our knowledge, more importance is perhaps to be attached to the hygienic treatment of the disease than to the curative. Most important of all, perhaps, is the exposure of the patient to abundant, freely changing air; next is the use of cold or tepid sponging, as the temperature of the body and the state of the skin (as well as the sensations of the patient, if he be sensible) may seem to call for; together with the large administration of drinks (acid—? mineral, or other) to combat the thirst, the judicious use of liquid food, and especially of stimulants when the dropping of the pulse, the coolness of the skin, and the ataxic condition of the patient call for them.

Prevention.—The prevention of plague involves two sorts of considerations, the one relating to the removal of the conditions which favour the development of the disease; the other to the limitation of the spread of the disease, the malady existing. (*a*) The conditions favourable to the development of plague have been already enumerated, and include all those insanitary states of houses, their sites and surroundings, which form the subject of public-health administration; also those states of poverty which have to be dealt with, not only as an economic but as a public-health question. Of these several conditions, the three which would seem most to call for special attention in this country, in view of impending plague, whether as regards private individuals or as regards local authorities representing communities, are *over-crowding*, *defective ventilation of houses*, and *impoverishment*. (*b*) In respect to the limitation of the disease, the malady being present, the first and most important consideration is the *isolation* of the patient under such circumstances of aëration as are stated above, as well in the interest of the patient himself as of the community; and the *disinfection* of articles of clothing, or bedding, used by him, and of the room he may have occupied. Local authorities have large powers enabling them to provide beforehand, in a mode available for the use of the whole community, (Public Health Act, 1875, and the Metropolis Management Act, 1858, together with the Sanitary and Poor Law Acts relating to the Metropolis), hospitals for the isolation of cases of infectious diseases, such as plague, and

apparatus and materials for disinfection and many authorities have already exercised these powers. *See* PUBLIC HEALTH.

But *plague* is the subject of special measures in this country, as in every country on the Continent and Mediterranean littoral, to wit, measures of *quarantine*. Quarantine aims at preventing both the introduction of the disease into a country, and the spread of the disease, if by accident it should happen to have been introduced, by the isolation for a longer or shorter period, not only of persons *sick* of plague, but, in addition, of *all healthy persons* who may have been exposed, directly or indirectly, to the infection of plague; also by the isolation and disinfection of articles, described under the quarantine law, as susceptible of conveying plague-infection, coming from an infected district. Experience has shown that measures of quarantine against infectious disease are futile, if not impracticable for this country, from the impossibility of closing all channels of introduction, in consequence of the activity and magnitude of our commerce. But quarantine is retained in regard to plague and yellow fever, and has occasionally to be made use of to meet the requirements of other nations, who, failing the adoption of this system here, would be likely to impose disabilities on our shipping with reference to the diseases named. Thus quarantine was revived in respect to plague, at the time of the recent alarm of the disease on the Continent. The doctrine of plague upon which the English Quarantine Act of 1825 is based, as well as the laws of foreign countries relating to the subject, is a traditional one, inconsistent in many respects with the later and more accurate observations which have been made on the mode of spread of the disease.

J. NETTEN RADCLIFFE.

**PLESSER** } (πλήσσω, I strike).—A hammer-like instrument used in percussion, for striking the surface of the body, either directly or indirectly. *See* PHYSICAL EXAMINATION.

**PLESSIMETER** } (πλήσσω, I strike, and μέτρον, a measure).—A flat instrument used in mediate percussion, by being applied to the surface of the body to receive the stroke of the plessor. *See* PHYSICAL EXAMINATION.

**PLETHORA** (πλήθω, I fill).—Fulness of blood. A condition in which the vessels of the body generally, or of any part, are over-distended with blood. *See* BLOOD, Morbid Conditions of; and CIRCULATION, Disorders of.

**PLEURA, Diseases of.**—The serous membrane which lines each cavity of the chest, and is so reflected as to cover the lung, is not unfrequently the seat of disease. As in its anatomical and physiological relations, so also in its diseases, it presents analogies to the lining membrane of a joint. Its diseases may be of external or of internal causation. They may be considered under the following headings.

1. **Pleura, Injuries of.**—These may be caused in several ways: (1) by violent blows upon the chest, and in this case there is usually at the same time an injury to the lung-tissue, the effects of which to some extent overshadow the pleural lesion and its results; (2) by direct wounds with a knife or blunter instrument, or a bullet; and (3) by fractured ribs. In each case inflammation of the pleura may occur. With the surgical aspect of these cases we here have no concern, and the pleural consequences may be sufficiently gathered from the following paragraphs.

2. **Pleura, Inflammation of.**—SYNON.:—Pleurisy; Fr. *Pleurésie*; Ger. *Pleuritis*.

DEFINITION.—Pleurisy is defined as an inflammation of the pleura, of whatever nature and extent. Clinically and pathologically, pleurisy differs only in its accidents from inflammation of serous membranes elsewhere, and is the most common of the serous inflammations.

ÆTIOLOGY.—The causes of pleurisy, if local, may be obvious enough; if general, not so obvious. Of local causes the chief are wounds or bruises of the chest-wall; fracture of the ribs; caries of the spine; escape of irritating matter into the pleural cavity, whether from the costal side, as in periostitis or osteitis, from the pulmonary side, as in phthisical excavation, from disease of the bronchial glands, or from the side of the abdomen, as in gallstone, hydatid, subphrenic abscess and the like. Foreign bodies, again, such as bones or coins from the œsophagus or larynx, have been known to find their way into the pleural cavity, and thus set up mischief. Acute pleurisy, the result of local causes, is usually more or less proportioned to these in its severity and duration; pleurisy of general or systemic causation, on the other hand, though less regular in its career than pneumonia, has yet a certain character of uniformity. The general or systemic causes of this form of pleurisy are very obscure, and none of them are accurately known. There are some grounds for suspecting that a chill alone may be a cause of acute pleurisy; but more probably we have to learn that chill must be associated with other factors. A rheumatic or gouty habit is suspected to be a disposing condition by many, and probably with good reason. The depression of overwork or harass, the debility of former illness or of convalescence, and the poison of malaria are among the more common disposing causes. Acute pleurisy again often occurs as a part, or as a complication, of other diseases. Thus it is rarely absent in acute pneumonia; and it occurs, as cardiac valvulitis and pericarditis occur, in acute rheumatism, but less frequently. Acute pleurisy following scarlatina is probably dependent upon a rheumatic or nephritic sequel; if it arises otherwise in the malady the pleurisy is more often of the profuser kind and tends quickly to empyema. Pleurisy arises sometimes after measles, when it is probably due to pneumonic irritation. It is also a common consequence of diseases of the kidney, in which maladies hydrothorax may be simply dropsical or the product of pleuritis. In septicæmia and in pyæmia, again, a low pyogenic pleurisy often arises as like effusions arise in the joints, and may be equally or more latent; or it may be caused by the rupture of a pyæmic abscess of the lung into

the pleural cavity.[1] Acute pleurisy, when 'idiopathic,' is more often on the left side (3 to 2) and is rarely bilateral. When due to more specific causes, such as acute rheumatism or nephritis, it is often bilateral, though rarely of equal severity on the two sides. Acute pleurisy is common at all ages; it is recorded often within the first six months of life; in babies it is readily overlooked unless there be abundant effusion, and not rarely even then. In children the symptoms are often very latent, neither cough nor pain is manifest, and there is little displacement of viscera; yet it is really more common under one year than between the ages of two and five years. At the age of five it is frequent, but it reaches its maximum frequency in middle life (æt. 35–45). The younger the child the more readily the effusion becomes purulent, and in such cases the mischief often extends to the pericardium. Cases of simple inflammatory pleurisy have been recorded in persons beyond threescore years of age; but in aged persons it is rare, and presents little reaction or pain. The male sex is more often affected than the female, in the ratio of about seven to five, the difference being probably due to the class of cases which owe their origin to weather. It does not appear, however, that pleurisy varies in prevalence with the change of the season. Pleurisy, under one form or other, is credited with about 2 per cent. of the deaths in England, and with about 1 per cent. of the deaths of patients in public hospitals.

Anatomical Characters.—The morbid anatomy of pleurisies differs but little from that of serous inflammations elsewhere. The costal membrane generally suffers the sooner and the more severely. The vessels become injected and even yield in places, giving rise to small irregular ecchymoses. Effusion of a sero-fibrinous and proliferative kind quickly infiltrates the tissue, and the natural gloss of the membrane gives place to opacity. The superficial epithelium also strips off and papillæ appear, at first isolated, but soon communicating together by networks of vascular formation. At this point all may clear up, or effusion may escape from the surface. In dry pleurisy the products are chiefly new-tissue elements, without much interstitial effusion. In active cases the effusion is not very voluminous, but is very rich in fibrin; and false-membrane, often of great thickness, forms upon the pleura, and sits tightly. Some of this loose or adherent gluey effusion degenerates, and is absorbed on resolution; some of it organises, and forms more permanent false-membrane or bands of connection and adhesion. Into these enter blood-vessels, elastic fibre, lymph-channels and even nerves (Virchow). Clots of fibrin float freely and abundantly in the effused serum, and contain a great abundance of imprisoned cells. In the fluid itself the cells are fewer, clear, granular or multinuclear. The more of these cells the greater the fear of a purulent transformation. There are also found abundant free nuclei and a quantity of red blood-corpuscles, varying with the vascularity of the new growths. If the exudation be less actively inflammatory and more serous, it is also more abundant, and may amount to 100–150 ounces. It is less disposed to form firm membranes or adhesions. This fluid is of a greenish straw-colour, like synovia, and is thin, with flocculent lymph in it. It partially coagulates when exposed to the air, and is found to contain more degenerated cell-elements, tending towards a sero-purulent character. In scurvy, tuberculosis, carcinoma and other cachexias, and even in rare cases of simple pleurisy, the effusions may be highly sanguineous, and blood may be found alike in the coagula, in the free and in the attached false-membranes.

When the contents of the pleura are purulent, much of the new membrane has broken up, though even here false membranes are far from being absent, and fibrinous clots are at times discovered. In cases of large effusion the lung is found compressed, and often bound down by false-membranes extending from the walls of the cavity. In adults the lung is usually found in the vertebra-scapular space, being thrust upwards, inwards, and backwards. It may be compressed from one-quarter to one-eighth of its normal volume; is flattened, leathery, bloodless, and airless; and will sink in water. As the pressure subsides the lung may, and generally does, recover more or less of its former volume. It is surprising to see how successfully re-expansion may take place in spite of false-membranes, bands, and prolonged compression. Nevertheless either complete or partial adhesions or bands of connective tissue generally remain indefinitely after acute pleurisy; and happily for the most part do little harm. If the lung fail to re-expand to any extent, its deficiency is made up by the inward pressure, partly of neighbouring soft parts, and partly of the chest-wall. Pleuritic adhesions are very commonly found after death from other diseases, the origin of them being unknown or forgotten. On the other hand, false membranes and bands may become the seat of degenerative processes; and pus, cretified pus, tubercle and the like may be found in them, with or without secondary abscesses elsewhere. A pleural cavity which has thus suffered is more liable to subsequent inflammations. The compressed lung in like manner is liable to become the seat of degenerative disease, and in empyema the contact of pus promotes ulcerative and septic changes in the lung, as it does likewise in the vertebræ, ribs, and other neighbouring parts. In this way the pus, finding for itself a passage in the direction of least resistance, pierces through lung or thorax, and establishes a pulmonary or costal fistula. Sometimes the pulmonary fistula is a simple one, and communicates at once by a free or a valvular opening with a bronchial tube, or may have so communicated by an opening afterwards closed; at other times the pus finds a less direct route, and either by a transference like filtration, or by way of a number of lesser ulcerating channels, it reaches the more open passages of the lung.

Subpleural ecchymoses, though often accompanying evidences of inflammation, are not

[1] The origin of the pleurisy which may accompany puerperal and other diffuse peritonitis is explained by Von Recklinghausen's demonstration of lymph-canals between the diaphragm and the pleura; and its supervention in cases of abscess of the liver may receive a like explanation. Reversely septic pleurisies spread themselves sometimes from the pleural to the peritoneal cavity.

always caused by pleurisies. They occur in deaths of children after broncho-pneumonia and diphtheria, but there is usually a patch of pleuritic inflammation upon and co-extensive with them. They are not uncommonly found in other deaths also, but are probably always associated with obstruction to the entrance of air into the lung.

In all cases the position of the heart and other viscera must be observed, and the chambers of the heart, the pulmonary veins, and other vessels examined for clots. In empyema a careful examination of the body for secondary abscesses must be made, not forgetting the brain.

Clinical Characters and Varieties. — Pleurisy may be conveniently divided into kinds, according to certain pathological and clinical differences, as follows:—(α) *Dry*; (β) *Acute*; (γ) *Diaphragmatic*; (δ) *Quiet, with large effusion*; (ε) *Tubercular*; (ζ) *Fibroid*. Each of these requires separate consideration.

(α) *Dry Pleurisy.*—This is so called because it is attended with no effusion, or with effusion so slight as to escape notice. Usually, if not always, it results in an adhesion of the opposite surfaces of the membrane. It may not be revealed by any sign or symptom during life. Adhesions, more or less extensive, due to this process, are very often found after death. Dry pleurisy may occur alone, or as a complication of irritative changes in neighbouring tissues, as in the lung or chest-wall. Pain or pyrexia, more or less fugitive, may accompany dry pleurisy, but in many cases if present they pass unnoticed. Should attention be drawn to the chest, friction may generally be detected. An obscure pain in the chest or loin, or a frequent teasing dry cough, may at times be traced by the close observer to a patch of dry pleurisy in some part of the chest. A friction-sound due to such a patch may be transient, or may be audible for many weeks. Recovery follows adhesion. It is supposed that some of the pains in the chest which accompany phthisis are due to the intercurrence of dry pleurisy; probably, however, they are as frequently myalgic or neuralgic. Dry pleurisy, with its resulting adhesions, is rarely injurious. Indeed, it is rather a safeguard when any destructive process, such as phthisical ulceration, threatens to bore into the pleural cavity. If it fail, and morbid matters escape into the cavity, acute pleurisy is the probable consequence. Dry pleurisy often ends in but slight thickening, the two pleural surfaces adhering without much increase of substance. In other cases the thickening may be considerable, but this probably indicates some more persistent irritation, such as we find, for example, in those dense coverings which often surround the apex of a lung in chronic phthisis. The remoter consequences of dry pleurisy are for the most part without importance. In some instances it may limit the chest-movements, or, more rarely still, may so tie the parts as to cause abiding pains, described as dragging or tightening. Such pains are usually referred to the sub-axillary or sub-mammary regions, and may be really annoying. More often they do harm by ministering to needless fears. It is said that in rare cases hypertrophy of the heart has resulted from the embarrassment of its action by pleural bands. Dr. Bowditch tells the writer that he has seen this twice at least. It is useless to prescribe treatment for a disease which escapes observation, or is but a secondary event in the course of more serious processes. Where dry pleurisy is found, and is doing harm by exciting cough or otherwise, the best practice is to place several light blisters in succession over the affected part.

(β) *Acute pleurisy.*—Acute pleurisy, though less serious than chronic dropsical pleurisy, is far more serious than dry pleurisy, and generally appears as an important illness. It sets in with fever, pain, embarrassment of the breathing and cough, sometimes catarrhal, mostly reflex. These symptoms bear no certain proportion to each other. The fever has no very characteristic type, but is rather what is known as a symptomatic pyrexia. Thus there is not a sharp rigor of onset, as in pleuro-pneumonia, but there is often a succession of chills. Nor are there any very definite stages of increment and acme, but rather a daily fluctuation of remittent, more rarely of intermittent type, with evening rise, the elevations not often reaching and rarely exceeding 40° C. (104° F.) At first the arterial tension is high, the pulse being small and hard; after the first onset the tension falls, and the pulse becomes dicrotic. As the effusion reaches its height the fever in acute pleurisy gradually recedes, unless the case approaches to the form δ, when the effusion is indeterminate, and the fever may subside, may fluctuate, or may drift into hectic. The pain is often very characteristic, but at other times is variable, and even delusive. Most commonly it appears as a stitch in the side, about the level of the false ribs, which is intensified by inspiration and cough. The deep breath when partly drawn is cut short, as if with a stab, while the face of the patient is wrung with an expression of sudden distress. Such inspirations are, however, instinctively avoided, and may have to be called for by the physician, so that the face may speak rather of apprehended than of actual suffering; in either case the expression is a telling one to the practised observer. The fixed alæ nasi, which are dilated but do not oscillate, as in some other kinds of dyspnœa, the parted lips, the bright eye of fresh fever, the cheeks flushed, but not congested as in pleuropneumonia, the preoccupied and apprehensive expression, the posture semi-erect, slightly bent forward and toward the affected side, the shallow breathing, the fixed chest, the hand on the side, the curt speech, the stifled cough, make up a clinical picture often seen, and easy of recognition. It is a curious fact that these symptoms of distress are generally more marked in a robust patient, or one previously healthy, than in the ailing, weakly or cachectic. The pain, however, may wander from the lateral or ante-lateral aspect of the lower ribs, and appear in the hypochondrium, or even on the opposite side. At other times it may become more diffused, and play upon the brachial plexus, darting from the clavicular and scapular districts to the upper chest, shoulder or arm. This is, perhaps, more common in the diaphragmatic variety (γ). In some bad cases, in which pus forms from the beginning or almost from the beginning, the pain is very distressing and

prolonged, and the rigor very strong. Whatever be the treatment, we look for some relief of pain, cough and conscious dyspnœa on the third or fourth day.[1] The respirations, however, may still range above the normal rate, from the mechanical interference of increasing effusion, or of this increase combined with œdema of the open parts of the embarrassed lung, and perhaps of its overworked fellow. About the end of the week, be it more or less, the pleurisy has run its course, and the effusion has, in favourable cases, attained its maximum; the urinary, gastric, and other glands regain their normal activity; and convalescence, with absorption of the exudations, is to be looked for. Thus far, then, the disease is painful rather than dangerous, death in the first week of ordinary acute pleurisy being practically out of the question.[2] By certain signs in the chest we know the height to which the fluid has flowed in the cavity, and we await its ebb. Usually, in a day or two, some fall is noted, and in favourable cases this ebb runs quickly at first, and afterwards more slowly as the products become denser. Some remnant is usually to be detected after the patient is about; and months, or even years, may elapse before the parts become normally clear. Indeed, the signs of an old pleurisy may be carried to the grave. Likely as is this favourable result in strong persons, yet it is not to be too lightly promised even to these. Too often when we are awaiting the ebb we find a new flood, the level of the fluid rises into the upper chest, and the patient, who hitherto has lain on the sound side to avoid pain, now turns on the affected side to give full play to the open lung. This flow may recur with or without renewed fever, but is generally attended with a proportionate increase of pulse-rate, and diminution of pulse in volume and tension. Coincident with the diminution of arterial tension, which in its turn is due to the pulmonary obstruction, is a diminution of the urine, which, probably, had become more abundant as the fever ceased. That the changes, both of pulse and urine, depend upon the effusion, is shown by the rapid recovery of both when fluid is artificially let out from the pleura: the pulse then falls in rate and increases in tone under the finger, and the urine soon becomes more abundant. A little albumen is sometimes present during the time of pulmonary obstruction. Under ordinary circumstances a renewed flow of urine may be indicative of pleural reabsorption, or the case may pass on into the form γ, or into an empyema. Neither event is common, however, except as a consequence of neglect, the symptoms preceding these events being generally of a quieter character. It is hard to tell when the full chest contains *serum*, and when *pus*. Marked hectic may exist with serum, but if this be associated with increased temperature of the affected side, with change of countenance, loss of appetite, wasting of flesh, failure of strength, thrush, diarrhœa, or with any of them, and the more if there be any inherent constitutional frailty, or a septic element present, we must fear that the fluid is turning to pus. In the later weeks or months of an acute pleurisy which has not ended in resolution, death may threaten and may not be averted. In some cases, as after scarlatina, the effusion may be purulent from the beginning, and a fatal result may be feared even in the earlier days of the malady. Under ordinary circumstances, however, in healthy persons who have been carefully treated from the outset, and who have not been exposed to septic or malarious influences we expect to have to deal with effusions moderate in quantity and stable in quality. The effusion in such cases rarely remains at its height more than two or three days; and in three weeks at farthest absorption should be tolerably complete. In other cases, fortunately rare, acute pleurisy, with remittent fever, continues for many weeks. Effusion in these cases may not be very rapid, but recurs gradually after the removal of moderate quantities; or it may be so moderate, indeed, as scarcely to need removal. The signs are simply those of acute pleurisy, but resolution does not take place, or is indefinitely deferred. Death may result in such cases, or the patient may slowly recover. After death are found evidences of active simple inflammation, partial or complete obliteration of the lung, and sero-fibrinous exudation. The other side, and the rest of the body, may be quite healthy. The name *relapsing pleurisy* might be given to these cases. When inflammation falls upon both pleuræ, it generally falls also upon the pericardium, and such cases are terribly dangerous. Even if moderate in degree in each, yet taken together the embarrassment of the patient becomes very grave, and death imminently threatens. It is important to give relief by puncture as early as possible.

(γ) *Diaphragmatic pleurisy.*—Diaphragmatic pleurisy is not essentially different from the preceding, but the symptoms are peculiar.[1] If the inflammation be, as it may be, exclusively diaphragmatic, and not costo-pulmonary, then the ordinary physical signs of pleurisy with effusion are either absent, or so ill-marked as to puzzle the inexperienced practitioner. In diaphragmatic pleurisy the patient is taken as acutely as in ordinary pleurisy, or the fever may even be higher; but his distress is different, greater, and more serious. The practitioner is surprised and perplexed to find a person, in whom he can discover no important organic defect, in an agony almost mortal. The presence of pain shooting from the lower ribs of one side suggests pleurisy; but the ribs of both sides play with perhaps more than normal freedom, and no physical signs are audible, unless it be that the practised ear may detect a want of breath-murmur at the base of one lung, and, after

[1] Writers are not yet agreed whether there be any local elevation of temperature in the affected side or not. Still less can it be said whether such local temperature runs any definite course of change.

[2] Malignant cases are related of pleurisy, in which the temperature remains at 40° or 41° C. (104°, 105·4° F.), the pulse reaches 140, the tongue becomes dry and brown and prostration excessive, and the exudation runs promptly to pus. Such cases are rare, except as complications of septic and other diseases, and they are almost surely fatal, even after free evacuation of pus by incision.

[1] Wintrich is indisposed to admit that the symptoms of diaphragmatic pleurisy are as characteristic as herein described. Diaphragmatic pleurisy may perhaps exist without setting up such marked and special symptoms.

the first day or two, it may be, two finger-breadths of dulness there. Still no friction may be heard, and it seems impossible at first sight to credit signs so slight with clinical phenomena so alarming. For the patient is as one having a clot in the heart, or a sudden perforation of the pleura, so terrible and so absorbing is the strife for inspirations which never satisfy, so keen the dread of any handling which may interfere with the one permanent need of sitting erect, and of keeping every respiratory muscle in full play. These inspirations may range from forty to fifty in the minute, or may even run with the seconds, except only when cut by a hiccup or a heaving of the stomach. To this are added the suffering of pain which shoots through the waist to the back, or darts round the shoulder-blade and collar into the shoulder, and an impending sense of dissolution. The fever is perhaps not actually higher than in ordinary acute pleurisy, and the normal character of the heart-sounds gives great confidence to the physician. Abdominal breathing, however, rather than thoracic is instinctively lessened, and any pressure upwards upon the diaphragm is resented. All these things finally lead to the conclusion that acute inflammation has partially attacked and so far paralysed the diaphragm, without extending far upon the pleura above; and the diagnosis is of course the easier if pleurisy is discovered elsewhere in the chest. A patient thus attacked seems to be in no little danger, but recovery may be anticipated. Fortunately the malady is far less common than ordinary pleurisy, and indeed may be called rare. As stated above, however, inflammation of the diaphragm may complicate ordinary pleurisy, and introduce both the pains in the brachial plexus, and the excessive and paroxysmal dyspnœa.

(δ) *Quiet pleurisy with effusion.*—This form of pleurisy is commonly said to be the sequel of acute pleurisy; but if we except a few cases in which pleurisy, at first sthenic, afterwards follows the asthenic tendencies of the patient, and those in which acute pleurisy has been treated with neglect, we shall find that in the large majority of the remainder this form begins not sharply but quietly, and indeed is often unnoticed until the chest is laden with fluid. If the patient suffered pain it was too slight or too indefinite to ensure attention; the low fever, unmeasured by the thermometer, escaped observation; the chest, slowly invaded, accommodated itself to circumstances until the fluid had nearly filled the cavity; and even then the patient may be brought to the doctor only by a sense of dyspnœa on ascending hills or stairs. A quick eye may detect in him an expansion of the alæ nasi; or, indeed, may see that the patient—almost unknown to himself—is breathing at double, or nearly double, the normal rate; or, again, a sensitive patient and a vigilant physician may fully perceive the remittent—almost intermittent—fever, the indefinite pain and the encroaching effusion, and may lessen the evil by timely interference. As a rule, where effusion is large the patient lies on the affected side, thereby escaping the pressure of the fluid upon the mediastinum, and enabling the sound lung to have free play. This decubitus is not, however, invariable, and is avoided if the affected side be painful. With pyogenic change in the effusion the patient may turn off the affected side, as this change sometimes is accompanied by a renewal of tenderness to pressure. When the effusion has come on very gradually, the patient may be able even to lie on either side indifferently. In a few cases a large pleural effusion may cause some difficulty of swallowing, but this is rare. Let the reader then remember that pleurisy running to large serous effusion not only may be, but generally is, quiet; and not only may be, but not uncommonly is overlooked until matters come to an extremity. In like manner, if the effusion be purulent its accumulation may be equally rapid or equally silent; being silent when it is the further change of a serous effusion, being silent and rapid when it comes as pus almost, if not quite, from the outset, as in septic and infectious diseases, and in children. If acute pleurisy drifts into chronic pleurisy, the fever, which may have vanished for a time, lights up again fitfully, and fresh brushes of inflammation take place in the pleura and in the new membranes. With this there are also renewed outpourings of serum, and these sometimes increase so rapidly as to put the patient in imminent danger of death by syncope. The fever in these stages is often hectic in character, so that the presence of hectic alone does not prove the effusion to be purulent. Quiet dropsical pleurisy is very uncertain in duration. Should the effusion be not excessive, and remain serous, months may elapse—nay, even years—before it is absorbed; and the absorption may be gradual, or may be deferred for awhile, and then completed more quickly. It is needless to say that even so favourable a result as this cannot do away with the injury which the chest must suffer from being water-logged for so long a time. Very frequently, however, the effusion becomes sero-purulent or purulent; and if left to itself finds an exit gradually by many little ulcerated spots through the filtering lung, and so is gradually expectorated; or by an opening into a bronchial tube, rushes with a sudden and copious discharge into the mouth. The expectoration in the former case is usually profuse, inoffensive, and muco-purulent; in the latter, the gush of pure and often stinking pus is sometimes so great and so sudden as to swamp the lungs and threaten suffocation, especially if it occur during sleep. In either case we have to deal with a subsequent pyopneumothorax, which, if left to itself, will probably end in death by slow hectic and marasmus. The issue is more promising if the pus find its way outwards between the ribs, and this it may do by a direct opening or a sinuous opening; or it may gather between the ribs and skin, forming there a large superficial abscess—'*empyema necessitatis*,' the tension of which varies with respiration and increases with cough, and these of course more or less readily as the communication is more or less direct. These changes in tension aid in distinguishing such issues from the pleural cavity and local abscesses of the chest-walls. In these cases, however, the chest is imperfectly emptied; septic poisoning is but partially prevented; and a lingering illness is only to be

cut short by operation. Again, the pus may find its way into the opposite pleura, thus doubling the empyema, and such cases have recovered; or into the pericardial or peritoneal cavities, though such terrible events are fortunately rare; or it may burrow between the tissues and appear at distant places, and thus may mimic psoas or other sinuous abscess. A cure of empyema by resorption is said to be possible, but the possibility must be a bare one.

In some cases the fluid may rise in twenty-four hours from the angle of the scapula to the clavicle—an obliteration of breathing space far more terrible in its rapidity than a more gradual one to which the system slowly adapts itself. This affection has no definite course, for absorption is difficult, and so far as it occurs is too often compensated by renewed febrile movements, with renewed effusions. The lower character of the new-formations, their lack of vessels, and the compression of those which exist, hinder such absorption as may be possible in weakly persons. The fluid sooner or later becomes purulent, and makes for itself an outlet.

(ε) *Tubercular Pleurisy.*—In considering the relations of pleurisy to tubercle we have to deal with four classes of cases:—1. Those in which one or more attacks of pleurisy, not apparently itself tubercular, have preceded phthisis. 2. Those in which tubercle arises in the exudations of a pleurisy thitherto simply inflammatory. 3. Those in which pleurisies spring up here and there in the course of pulmonary phthisis. 4. Those in which the pleurisy is tubercular in its origin and development.

These states will be best considered reversely, beginning with the last. True tubercular pleurisy is not uncommon, but, apart from tubercle in other parts, rarely or never destroys life, and, being a part of general tuberculosis, is not therefore found alone upon the *post-mortem* table. Tubercle, however, sometimes betrays its presence in the pleura before it manifests itself elsewhere, so that the occurrence of pleurisy without definite cause in a delicate person should always excite suspicion, and this the more if patches of inflammation spring up here and there in the membranes of the two sides without much resulting effusion. For the fluxion of tubercles is rarely sufficient in degree or kind to produce much effusion. No great difficulty arises in deciding upon the nature of those intercurrent pleurisies which are coincident with, and so often caused by, pulmonary phthisis in the neighbourhood. These very commonly are not tubercular in a strict sense. More difficulty will be found in foreseeing or detecting the birth of tubercle in the false membrane of a pleurisy apparently simple. Tuberculous pleurisies of this second class are not uncommonly met with in practice, and followed to the *post-mortem* table. A pleurisy, severe or not, but seemingly of simple nature, progresses towards recovery, and perhaps, indeed, reaches apparent recovery. The temperature, however, if it has fallen, fitfully rises again and the pulse quickens, yet without much evidence of empyema or of any returning effusion. Presently a patch of pleurisy on the other side, or a sign of mischief at the apex of a lung, betrays the character of the relapse. These cases end as more or less generalised tuberculosis, and in the old false-membranes are found the caseous or softened residue of the first crop. Most difficult of forecast are the pleurisies of the first class, which, however painful or profuse, end in recovery which seems complete. The patient, who has returned to the labours and delights of life, begins, however, to be hectic and to cough shortly and drily; signs of phthisis are detected in the lung; and the end comes in the too familiar way. There is little more to be said under this head, but to urge the physician to look upon all pleurisies jealously, and to regard with positive anxiety all pleurisies, however frank they may seem, or however happy in their resolution, which arise in delicate subjects, or in the members of families tainted with consumption.

(ζ) *Fibroid Pleurisy.*—Sometimes as a primary affection, but more often as an ultimate consequence of ordinary or of latent pleurisy, the membrane slowly thickens, and allying itself with a like irritation of the connective elements of the lung, increases at the expense of the proper tissue of the lung, and gradually contracting after its kind, stifles and destroys a great part of that organ. Fibroid pleurisy generally begins at the base of the lung, and the pulmonary membrane may increase until it forms a dense leathery covering of perhaps one-third of an inch in thickness. The disease is very chronic, and as the irritative overgrowth of the connective elements slowly advances into the lung, and is chiefly important as affecting the lung, little more need be said about it in this place. Fortunately the affection is rare, and it has not therefore received the attention it deserves. Commonly it ends in fibroid pneumonia. Cough and dyspnœa, abiding dulness on percussion, with lack of expansion, symptoms of pulmonary irritation and bronchiectasis, all following a known attack of pleurisy, should excite suspicion of fibroid hyperplasia. The causes of this abiding irritation are very obscure; the abuse of alcohol seems to be among them.

Pleurisy may be attended with other peculiar features of not sufficient importance to justify its division into further varieties. For instance, it may be attended with *hæmorrhagic exudation*—that is, with exudation mixed with more or less blood. These cases, though sometimes very acute, are usually chronic; and the hæmorrhage depends on bleeding of the new vascular tissues, which partake of some further abnormal state of the patient, such as scurvy, carcinoma, or even phthisis.

Physical Signs.—These are to be detected by the usual methods. Throughout the stages of the disease *inspection* will tell us that the movements of the affected side are lessened either by the warning of pain indirectly, or directly by effusion which stops the play of the lung. This diminution of movement is often to be noted also in the abdomen on the same side, especially in diaphragmatic pleurisy. If the effusion greatly increase, the chest may or may not be seen to bulge beyond its true lines; the intercostal spaces are usually flattened up to the level of the ribs, and the form of the affected moiety of the chest becomes more cylindrical, as is best shown by the cyrtometer. The diaphragm may be

so thrust down and forward as to cause a fulness in the epigastrium; in large effusions there may be bulging even of the supraclavicular space; and the outline of the affected side measured in the transverse submammary line will usually measure more than on the healthy side. Half-an-inch is an important difference, seeing that the other and healthy side in overwork expands in a young adult about half-an-inch or more beyond the normal, and falls again as the compressed lung expands after paracentesis. In recent effusions the skin is often obviously stretched. Œdema of the skin on the affected side may be present, and, though not decisive of pus, is less common in serous effusions. Though confined to the affected side, it sometimes extends far beyond the chest-wall. The state of the veins of the neck must also be noted, and of those upon the chest, as much enlargement of these would suggest intrathoracic tumour rather than fluid, as in like manner would inequality of the pupils, or other evidence of solid pressure within. Clubbing of the fingers may be seen in old cases of pleuritic effusion not necessarily phthisical. The presence or absence of a heart-beat, and its position if present, must be noted. If fluid be in the left chest a diffused pulsation in a tumid epigastrium often replaces the proper apex-beat, or the heart-beat may be felt or heard towards the right breast; if in the right chest this beat may be detected towards or upon the left axillary line. In some cases of limited but complete dulness in the anterior and inferior region of the left chest, it may be difficult to decide between fluid and pleuro-diaphragmatic adhesions. In the latter case tapping might be attended with some risk of perforating the diaphragm. M. Jaccoud says the distinction may be made in some cases of adhesion by observing traction upon the lower ribs and spaces in forced breathing, so that the spaces are drawn in on inspiration, and the ribs drawn towards the median line. But puncture in so dangerous a situation could never be desired. In some rare cases of empyema the whole of the affected side so pulsates as to simulate a large aneurism, a phenomenon which has not yet received a satisfactory explanation. Finally, in large effusions there is often some prominence in the hypochondrium of the same side; the nipple drifts farther from the sternum, and the shoulder-blade is thrust somewhat out and away from the spine. All these displacements and changes of shape are of course more readily brought about in young subjects, and in women more readily than in men. In children, also, we find proportionately less visceral displacement. The female diaphragm is more readily depressed than the male, and the right side of it more readily than the left. In neglected cases absorptive and atrophic changes tend to bring about a retraction of the affected side, the thoracic and intercostal muscles wasting, and the ribs falling together, with corresponding flexure of the spine, and great elevation of the heart or liver. Such a deformity may, indeed, be permanent if the lung be obliterated; happily this is not generally the case.

*Palpation* will help us to find the heart's beat; and to ascertain if the liver or the spleen be displaced. By the hand we may sometimes detect the creaking of friction; and we may verify the imperfect expansion of the side or abdomen, the levelling of the intercostal spaces up to the ribs, and possibly make out fluctuation in the former. The most distinctive sign to the hand, however, is the loss of the vocal thrill, which is arrested by fluid effusion. This is normally more distinct over the lower two-thirds of the chest. Here effusions usually first accumulate, and loss of this thrill is almost pathognomonic of them; for it occurs besides only with those intrathoracic growths which by their size or position close the bronchial tubes. Unfortunately sometimes, when most wanted, the voice fails to awaken a thrill in normal parts. Sometimes the limits of the thrill may give a gauge of the height of the effusion. Above the limits of the effusion the thrill is often more distinct than it is over the corresponding part of the sound lung. It must be remembered if compressed lung lie between the hand and fluid, that the vocal fremitus is none the less diminished.

*Percussion* of course reveals to us a higher or duller note over the whole extent of the fluid. But it cannot always tell us the amount of fluid present, as the level of this depends on the state of the lung, and of intrathoracic tension. Moreover, during absorption dulness depending upon thick false-membranes cannot be easily distinguished from that due to fluid. Such membranes may diminish vocal fremitus also. When fluid is present in quantity the note struck is dull, as if struck upon the thigh, and the stricken finger receives a peculiar sense of dead opposition, owing to the loss of resilience or vibration in the chest-wall. Extreme degrees of lung-consolidation, however, may rival fluid in these particulars. On the other hand, in effusion the level of the dulness may vary with the position of the patient, if its quantity be moderate, and it be unconfined by adhesions. Gravitation, however, helps us less in pleuritic effusions than in pleural and other dropsies, as in the former case the fluid is more liable to be sacculated, and may often be suspended by adhesion above the base line of the cavity. If the pleura seem full of fluid, but the lung be not much compressed, direct percussion by the finger-tips will give a very dull note and the sense of resistance, while stronger mediate percussion will bring out a note of somewhat lower pitch. Usually the level of the fluid is a little lower in front than laterally and behind, and the lung if free from much adhesion is usually pushed upwards, inwards and backwards, so that it may be detected by a clearer percussion-sound at the corresponding side of the four or five upper dorsal vertebræ. In acute pleurisy the fluid rarely rises above the third rib in front, but in quiet effusive pleurisy the whole moiety of the chest may become very dull upwards, and across to the opposite parasternal line, and there may be dulness and actual bulging in the supraclavicular space. When the chest contains a good deal of fluid, but is not full, percussion over certain areas may actually give a low or tympanitic percussion-note. These tympanitic areas may be of three kinds—1, where a thin layer of fluid lies over expanded lung; 2, where distended air-cells compensate cells closed in

another part; 3, where, the chest being full of fluid and the lung compressed and empty, percussion in the neighbourhood of the trachea and large bronchi causes vibration therein. Tympany when present is nearly always immediately under the clavicle. If the tympany be due to the third cause, it may have something of the cracked-pot quality. In some cases the tympany is decreased on inspiration and increased on expiration. The detection of tympany under the clavicle may mislead the unwary into a belief that the healthy side is morbidly dull, but on the other hand it is an invaluable help to the physician who takes it as a hint to look for fluid below. Dulness due to a displaced liver may be distinguished by the removal of its boundaries on inspiration, and by its anterior rather than posterior disposition. In mere hydrothorax the lung generally floats more readily, and the diaphragm and other structures can usually be made to move in respiration.

*Auscultation*, before any dulness appears, usually reveals the respiration at the part to be defective in quantity, rhythm, or quality; and there a friction-sound may be audible. Defective inspiration at the outset is due to arrest of that act; afterwards it is due to the false-membranes and effusion which hinder conduction of sound, compress the lung, and ultimately silence it. A friction-sound, if ever generated, may be fugitive and escape the observer, or the embarrassed chest-movements may fail to give it distinctness. When present it appears at the outset, and disappears as effusion separates the surfaces; it may reappear as the fluid is absorbed. The friction of outset may last but a few hours, and, except in dry pleurisy, is rarely abiding; returning friction, however, may continue for a longer time, even for weeks. In those cases in which the surfaces do not separate, and friction continues for many days without a break, we have to deal most frequently with the drier pleurisies of some cachexias or of septicæmia. Diminished breathing and friction, if effusion gathers, are followed by intermediate phenomena due to thin layers of fluid. These are bronchial breathing, bronchophony, and ægophony. Ægophony is nearly always heard near the root of the lung under the scapula; it has the character of a bleat, and when once heard is not easily forgotten. Its presence is pathognomonic of fluid;[1] but it is so often absent that it is of little practical value. As fluid increases these phenomena give place to silence, and as fluid gathers first at the bottom we often find silence at the base; bronchial resonance amounting, it may be, to ægophony at mid-lung; and defective or compensatory breathing at the apex. We may also meet with curious inverse changes in the physical signs, notwithstanding an increase of fluid, if at first this be spread over a partially expanded lung, and afterwards accumulate below it as the lung floats upwards, or as intrathoracic tension tells on the other side. Thus dulness may actually recede with an increase of fluid, and on the other hand it may rise upwards as with a diminution of fluid the re-inflated lung descends. For these and other reasons it is very difficult to gauge the ebb of intrathoracic effusions, or accurately to ascertain their behaviour after tapping. In children, bronchial breathing and bronchophony often persist throughout. Dr. Bowditch says that he has been occasionally greatly embarrassed in deciding about reaccumulations. 'At times after the effusion has been withdrawn the chest remains as flat as ever, and often it never clears up in the lower part of the affected side; but if it remains in this state without producing untoward symptoms, I have not tapped again, though a tentative aspiration could do no harm.' In cases where the lung is unbound, gauging is of course the more easy. When the chest is quite full of fluid there may be silence throughout to ear and hand; but even in such cases a faint or distant respiratory souffle is sometimes audible almost down to the base. Moreover, in most cases breathing more or less tubular, and some resonance on percussion, are to be heard over the root of the lung in the vertebra-scapular space. As air re-enters the lung, respiration is at first defective, and accompanied by crepitant *râles*, but it improves gradually, and reinforces itself as the lung expands and clears. In children silence on the affected side is less common, bronchial breathing and bronchophony persisting in them far more than in older persons; but it is not by any means correct to say that bronchial breathing and bronchophony always persist in the pleuritic effusions of children. Yet the pneumonia of children being mostly lobular the discovery in them of bronchial breathing and bronchophony is highly suggestive of fluid. In the other lung there is usually a slight general lowering of the percussion-note and compensatory breathing; if the effusion be large enough to compress the opposite lung, the percussion-note may be very markedly lowered. At times morbid sounds may be heard, even in the lung of the affected side. The gradual formation of a pulmonary fistula may in some cases be revealed some days or hours before evacuation, by the presence of liquid *râles* in the upper third of the affected side.

Physical examination must be applied not only to the investigation of the lung and of the contents of the pleura, but also to determine the position of those neighbouring parts which may be displaced, such as the liver, heart, spleen, mediastinum, and so forth.

*Pyopneumothorax.*—This is a term applied to that condition in which, on perforation into some open channel, air finds entrance into an empyematous cavity. At the same time pus is evacuated. The lung may in a measure expand, or in neglected cases may be irrecoverable; and the chest-wall falls in more or less, according to the rigidity of the ribs in the individual. Dulness now gives way to clearer and lower notes, except in such dependent parts as may still be occupied by effusion, and their pitch will vary according to the thickness and density of the false membranes within, and to the degree of pulmonary expansion. If the fistula be moderate in size, little or no blowing sound will be heard,

[1] Several modifications of pectoriloquy have been relied upon by Bacelli and other writers as means of distinguishing between pus and serum in the pleura. Dr. Bowditch informs the writer that the signs in question do not bear out the value which has been claimed for them; the phenomena probably vary, not with the density of the effusion, but with states of the lung.

but two additional auscultatory signs may be obtained, which are alike in nature, but are distinguishable as *succussion* and *metallic* tinkling. *See* **Pneumothorax.**

Diagnosis.— The difficulties of diagnosis in pleurisy belong chiefly to the earliest and to the latest stages of the malady. In the earliest stage the pleurisy may be latent, and so beyond the possibility of diagnosis; or a pain may be felt, and this pain may be due to pleurisy, pleurodynia, or other causes. The pain is often referred to the loin or abdomen, thus leading to suspicion of mischief elsewhere. In the previous history a catching of cold, and the arthritic diathesis, would tell equally in favour of either view; while prolonged anæmia and leucorrhœa would lead us to think of the latter. Unfortunately a comparison of local temperature in the two sides seems untrustworthy, but the presence of fever would make us strongly suspicious of pleurisy. It must not be supposed that diagnosis in this early stage is unimportant. Few errors are more common than the attribution of pleuritic pains to pleurodynia; the pain disappears as an effusion slowly accumulates, and mischief and peril, perhaps hardly remediable, may be the consequence. The careful observer will listen anxiously to the chest day by day, or more than daily, until a friction-sound be audible, and this once heard further mistake is impossible. Fever of course may be present with pleurodynia, and an immediate diagnosis would then be impossible, unless something characteristic in the stitch and start on deep inspiration betray the real state of things to the practised observer. Neuralgic and inflammatory diseases of the walls of the chest are not likely to give rise to any permanent misunderstanding. It is said that a pericardial may be mistaken for a pleuritic friction-sound, but the distinction can rarely be difficult. A difficulty is more likely to arise in distinguishing between a pericardial and a localised pleuritic effusion. Still this can hardly be insuperable. In rheumatic fever and in some other diseases pericardial may accompany or ensue upon pleuritic effusion, and when the latter is on the left side, and is abundant, the limit between the two may be beyond definition. The practical lesson is to remember the likelihood of pericardial effusion, and not to overlook it if it comes.

In the later stages of pleurisy, when effusion is abundant, its diagnosis may be very difficult. Under ordinary circumstances complete and extensive dulness, with loss of all elasticity in the chest-wall, of respiratory sound, and of vocal thrill, make diagnosis easy; and if there be resonance below the clavicle, its high-pitched character is very characteristic of fluid below. But there may be no such resonance, and the voice may fail, or fail to set up thoracic thrill. Moreover, vocal thrill and respiratory murmurs may vanish likewise in intrathoracic tumours. Thus the diagnosis between exudations and pulmonary consolidations is sometimes difficult. In acute pneumonia the course of the fever, the expectoration, and other symptoms, help us to a decision. In pleurisy with moderate effusion, on the other hand, the limits of posterior dulness might be changed by a few forcible inspirations, such changes being probably due to a re-expansion of collapsed lung. Consolidated lung could not, of course, be thus altered. In both there may be tubular characters of respiration, which are more easily distinguished in print than at times they may be in the patient. If ægophonic we decide upon fluid, but if bronchophonic we have to distinguish as well as we can between the 'sniffling and metallic' bronchophony (Walshe) of consolidation, and the duller and more diffused bronchial sound of pleuritic effusion. If the dulness and breath-sounds vary with the position of the patient, fluid is clearly present. Limited effusions, such as an encysted empyema, not large enough to bulge the intercostal spaces, to crush up the lung, or to displace other organs, are at times quite indistinguishable from a like extent of chronic consolidation, or of abscess in the lower lobe of the lung; such collections, though usually basic, are by no means always so, but, retained by adhesions, may occupy the upper and anterior region, any part of the middle region, or strips, or irregular districts in any direction. It may be said in general terms that a permanent *very dull* area remaining after an acute pleurisy or pleuropneumonia most probably corresponds to an encysted empyema, but not always. In such cases fever may be entirely absent, and the general condition of the patient may not suggest disease. Still, such a collection of pus is pretty sure to work mischief sooner or later—years later, it may be—but the patient rarely escapes with impunity at last. The difficulties of distinguishing bulky effusions from pulmonary consolidations are not often great. In the former the intercostal spaces may be bulged, and the moiety of the chest enlarged; on the other hand it but very rarely happens that consolidation reduces the lung to silence, though this may be the case; in such a case the bulk of the half-chest would in all probability be lessened, but so, on the other hand, may it be in a chronic pleurisy. The fact is, many chronic cases can be diagnosed by the needle alone; and it should be noted that even with the needle more than one puncture or two should be made before deciding against fluid. Between intrathoracic tumours and large pleuritic effusions a difficulty is found only in those cases in which the tumour occupies precisely the half of the chest, but this is not very uncommon, especially in cases of aneurism. It must not be forgotten too that fluid effusion may accompany tumour, in which case there may be subtympanitic resonance under the clavicle. In favour of fluid alone are the absence of enlarged veins; the equality of hydrostatic displacement of organs; the absence of signs of localised pressure, of pulse-retardation, of inequality of pupils, and of peculiar sputa. A curious pulsation, of uncertain explanation, is sometimes seen in empyema, and must not be mistaken for an aneurismal throb. If fluctuation be certainly felt in the intercostal spaces, the disease, in part at any rate, is a fluid effusion. Sometimes a hepatic, biliary, renal, or other subphrenic abscess, making its way by a sinus, occupies also some part of the pleural cavity. Here it may encyst itself, and remain latent or quiescent for months or years; or it may excite an effusive pleurisy in the

remainder of the cavity, so that two effusions co-exist in one pleura. Such collections may of course form pulmonary fistulæ, and pus from the same central source may in part issue from the urethra or rectum, and in part issue from the mouth. Such cases are often easy of diagnosis; at other times they are more difficult, especially if there be no fistula in any direction. When such pyogenic cysts contain air, but not by way of the lung, it may be supposed that they have originated in some perforative disease of stomach or bowel. It is obvious that in these cases there will be little evidence of increased intra-thoracic tension. Dulness from disease below the diaphragm, but encroaching on the thoracic space, can often be displaced downwards by a deep inspiration. It is stated that in puncture, combined with the use of the manometer, when the canula is in a cavity beneath the diaphragm, inspiration is attended with an increase and expiration with a decrease of pressure, being the reverse of that which occurs when the canula lies in the pleura. In peripleuritic abscess tension is of course low and there is no pressure on neighbouring organs; percussion-dulness is also less profound. It is said that pus from cellular abscesses is of higher specific gravity (1040) than from large cavities (1028–1030).

A hæmorrhage into the pleura can be distinguished from a serous or purulent effusion, only by a careful survey of all the history and symptoms; the direct physical signs helping us but little. Large pulmonary cavities may be taken for encysted empyema with fistulous opening into a bronchus; and here again, although a pulmonary fistula rarely gives rise to tubular breathing, unless the opening be very large, or communicate with a secondary cavity, yet diagnosis by the direct signs alone might be impossible. The history of the case, and the state of the other lung would be important factors in decision. In another class of cases the distinction between chronic phthisis and pleurisy may be difficult—in those, that is, in which there is some old dulness and retraction of a part of the side, with weak respiration and indefinite *râles*, and more or less fever. The absence of lung-tissue in the expectoration, and the health of the other side, help to exclude phthisis. Fibroid phthisis, however, is not even thus excluded, and is usually pleuritic in origin. In children enlargement of the spleen, with extension upwards and backwards, has not infrequently simulated effusion at the base of the left lung. Finally, the intense distress and orthopnœa of very painful pleurisies—of diaphragmatic pleurisy more especially—may simulate cardiac thrombosis. The state of the pulse alone is usually sufficient to lessen the fears of the physician.

Prognosis.—The prognosis of simple pleurisy, apart from tubercle or carcinoma, is generally favourable, unless the degree or kind of effusion in the chest endanger life. If not always favourable, it is because simple inflammatory pleurisies seem sometimes to originate a process of chronic fibrosis, which thence invades the lung. Happily such instances are rare, and in an individual case the chance of such an event almost vanishes. In ordinary inflammatory pleurisies, then, prognosis is quite favourable; in cases of effusion, where the effusion is moderate, it is favourable; where the effusion is large, it is the less favourable the greater the quantity and the slower the absorption. Signs of hyperæmia and œdema in the working lung must be anxiously watched, especially if an empty radial, scanty urine, and other evidences of venous stasis be added. When the chest is full, prognosis is unfavourable apart from operation. In severe and acute cases the other lung becomes œdematous and congested, bloody and frothy sputa may appear, carbonic-acid-poisoning will become evident in the blue lips and lethargic brain, the pulse will slip away, the heart fail, and the extremities grow chill; or, again, dislocation of the heart and arrest of the pulmonary circulation may cause syncope by asystole or thrombosis. Operation, however, raises the hope of recovery greatly—so much so as to put the chances largely in favour of rapid recovery in good subjects. The earlier the relief, the less the probability of refilling, the less the damage to the lung, and the better the hope of rapid amendment. In bad subjects prognosis will be the less favourable the more potent the adverse conditions; and in pleurisies secondary to other diseases the prognosis will depend but partially upon any one element in the case. In old people operation is still useful, but especial care must be taken to draw off the fluid very slowly, and to watch the circulation. The conditions in them unfavourable to operation are still more unfavourable to absorption, or to any kind of delay. In empyema the prognosis is grave; unless operation be performed death is very probable, either by syncope before the matter escapes, or by exhaustion, chronic septicæmia or secondary abscesses, during a long period of incomplete drainage of the chest. If operation be submitted to, the prognosis is favourable, though a vast internal abscess with rigid walls cannot be but a fearful thing, and the illness will still be a long and an anxious one. Death can scarcely be said ever to be due simply to the operation, if carefully performed; and death, during or directly following the operation, though not unknown, is too rare to be an important factor in our decisions or forecasts. On the whole, the earlier the operation is performed, after it is fairly indicated, the better the prognosis. Among the deferred dangers are amyloid disease, a rare event, but possible in cases of necrosed rib or other bone, or of very long and exhausting drain; and phthisis or septic tuberculosis, happily made also rare by the density of the false-membranes. The presence of albumen in the urine alone does not necessarily preclude complete recovery, nor forbid prompt operation. The bearing of age and sex upon prognosis cannot as yet be decided. Experience indicates that it is more hopeful in cases under ten years of age and above twenty years. Dr. Bowditch says that full pregnancy is no bar to thoracentesis. The influence of diathesis on the progress of local diseases must be estimated in all cases on general principles.

As regards duration, an ordinary case of inflammatory pleurisy will last from ten days to a month, according to the degree of effusion and

the rate of re-absorption. Chronic cases with large effusions may last any length of time, rarely less than three months. If tapped the fluid may, and very often does not return, or may not return after a second tapping; in such a case recovery will be prompt. Empyemas, opened under the most favourable conditions, are often months and sometimes years before final closure, though it seems that the antiseptic operation and dressings will much shorten the average duration. If left to itself an empyema usually opens through the lung or externally. In the latter case the issue is most commonly about the fifth interspace anteriorly. Drainage is thus very incomplete, and although some relief is attained, the patient nevertheless drags on with a permanent fistulous discharge, it may be for years, but recovery without operation is scarcely to be hoped for.

Finally, it must not be forgotten that simple pleurisies may be the forerunners of phthisis. The occurrence or repetition of a pleurisy in a young person of delicate habit or origin is always an alarming thing, and the more so if not due to obvious causes. The experienced physician will call to mind many cases in which a pleurisy to all appearance wholly recovered from at the time, was followed before many months had passed by definite signs of phthisis. There is no evidence to show that all such pleurisies are tubercular in nature. Lastly, a decided attack of pleurisy, occurring in the course of pulmonary phthisis, always means or makes mischief, even if quickly got under.

Treatment.—1. *Medicinal.*—Dry pleurisy requires little or no treatment. In some cases, indeed, it may cause distress, as in chronic phthisis; and if so, may be relieved by spongiopiline and laudanum, or by any similar soothing measures. In the cases in which a troublesome cough is caused by a patch of chronic dry pleurisy, the cough and pleurisy alike may be removed by the application of blisters. In acute pleurisy, however, much depends upon active treatment at the outset; in few maladies is early attention better rewarded, and in few is neglect more surely punished. Our great aim in the beginning is to diminish the pain, the inflammation, the fever, and the tendency to excessive exudation. With or without treatment, as we have seen, the pain usually passes off in forty-eight hours, or thereabouts; nevertheless it is very acute while it lasts. In sharp cases, occurring in healthy persons, we may put on six to twelve leeches according to the age, sex, or condition of the patient, and these may bleed freely into a large poultice. This measure, if adopted at the very outset, diminishes the pain, the fever, the exudation, and the duration of the case. When the bleeding has ceased the chest should be firmly bandaged, and as soon as the state of the leech-bites will allow of it, the affected side should be firmly strapped. This, by giving rest to the part, will favour resolution and resorption. Constant respiration, on the other hand, favours effusion, as exercise favours it in inflammation of a joint. If called to a case after the first brunt is over—say after a lapse of forty hours—it is better to omit the leeching, in order that the strapping may be applied at once. It must be carried out on the following plan, as laid down by Dr. Roberts, of University College Hospital:—

Strips of a properly-adherent plaster spread on some thick material, from three to four inches wide and of sufficient length, are applied round the affected side from mid-spine to mid-sternum, or a little beyond. These are laid on over a variable extent of the chest, according to the requirements of the case, it being sometimes necessary to include the whole side. It is best to make the application from below upwards, and to fix the strips of plaster in an oblique direction rather than horizontally. The patient being directed to expire deeply, a strip is fixed at mid-spine and drawn tightly, firmly, and evenly round the side in the direction of the ribs, that is, a little obliquely from above downwards and forwards; then another strip is laid on over this, also extending from mid-spine to mid-sternum, but in the opposite direction to the first, that is, obliquely upwards and forwards across the course of the ribs; the third should follow the direction of the first, overlapping about half its width, the fourth that of the second, and so on in alternate directions, until the entire side is included if required. Finally, it is often desirable to apply over the whole two or three strips horizontally, so as to form a superficial layer; and, if necessary, one or two may also be passed from behind forwards over the shoulder, these being kept down by another strip fixed round the side across their ends. Dr. Roberts applies the strapping in all cases from the outset. The writer's experience is in favour of early leeching in suitable cases, but it may be possible to combine the two remedies. This at the outset is far from easy, as a large poultice is almost an essential part of the leeching. Some physicians recommend that an attempt be made to subdue the local inflammation by the application of ice, but the results of this method are not satisfactory. In addition to local measures, such medicines as the following are required:—A powder consisting of Pulveris ipecacuanhæ compositi gr. v, and Pulveris antimonialis (James's) gr. iij, is to be given every six or eight hours, for two or three days. In diaphragmatic and in other cases, in which pain is a marked feature, the subcutaneous use of morphia is also to be recommended, in doses of one-eighth to one-fourth of a grain, or possibly more. The fever is rarely severe or protracted enough to require such vigorous antipyretics as quinine, nor is aconite a very safe remedy. It is better to give, in addition to the powder, full doses of Liquor ammoniæ acetatis (ʒij–ʒiv for an adult) every four hours, covered with a little milk; an alkaline effervescent being freely used also as a drink. Thus vascular tension is lessened, and activity of the skin and kidneys is promoted. In the earlier stages free purgation should be avoided, but it is well to call gently upon the alvine excretion by the use of mercurials and salines. All solids must be withdrawn from the dietary, and stimulants, as a rule, forbidden. The alkaline effervescent or a cream of tartar drink, with acetate of ammonia mixture, are to be continued after the powders are withdrawn, so as to keep up free excretion: for the same purpose, and also to lessen chest-movements,

the patient must be kept closely to bed. For some days after the subsidence of the fever the appetite for highly nitrogenous diet must be held in check, and it is desirable at this stage to lessen the amount of fluid in the dietary. Thus it is to be hoped that, as the patient's general condition improves, the effusion in the chest may likewise fall. If this be not the case other remedies must be brought forward. Among the chief of these are blisters, which, if not pushed to full vesication, may be repeated frequently; or the chest may be kept continuously under the effects of iodine, though this method is less successful than the blisters. At the same time, or soon after, a pill may be administered twice daily, containing a grain each of digitalis (fresh leaf) and blue pill. A grain of squill may be added, but squill has some tendency to disorder the stomach. The use of both blisters and mercury must, of course, be avoided if the kidneys be not sound, and mercury should be avoided in any case where a phthisical tendency is suspected. Dr. Bowditch applies a solution of iodine (℥ss in Spiritus etheris sulphurici ℥j), painting it on twice or thrice, or till burning is produced, and then reapplies it intermittently. He also administers iodide of potassium gr. v, thrice daily internally, and finds much help from this treatment. In vigorous patients free and repeated doses of some hydragogue purgative—such as Hunyadi water—may be tried before beginning the more tedious pills. Or the ointment of oleate of mercury may be rubbed freely into the chest, and this may be used even in delicate persons, without fear, and in those whose sensitive skins are intolerant of blisters. Quinine may be added to the mixture containing iodide of potassium, or may well accompany the mercurial course. But when a brief and gentle eliminative course of this kind is ended, it is well at once to turn to the full tonic treatment, with such drugs as iron and quinine. Less active effusions in delicate and anæmic subjects may need iron and bitters, cod-liver oil, and liberal diet from a very early stage, and such cases are common. At the same time such measures are not to be used while the acuter stages are present—a precaution too often forgotten; for even in phthisis a sharp intercurrent pleurisy must often be treated by salines, and perhaps a leech or two at first. These measures will generally succeed, in reducing not only an acute effusion of moderate extent, but also many effusions of a more obstinate kind. If, however, the case resist the means prescribed, the effusion will probably increase, and may need operative interference, as is so commonly the case in latent pleurisy. As a general rule, if an effusion rises above the angle of the scapula, and abides in this quantity or more for two or three weeks in spite of adequate treatment, it must be drawn off, whether the patient be embarrassed by it or not. In cases where treatment by medicines has not been fairly tried, where the patient is in comparative ease, where the effusion is not above the spine of the scapula behind nor above the mamma before, and where the neighbouring organs are not seriously displaced, these operations may give place to medicine for two or three weeks longer if desired. The writer, however, would advise the withdrawal even of a pint of fluid which had lain in the cavity for a month, as its continued presence, by soaking and compressing the lung, injures it, and destroys the absorbent power of the pleura and of its granulations. It is needless to add that if there be effusion in both pleural cavities, the amount in both must be considered as one quantity. Before resorting to operation, however, it is well to say that two more methods remain—the so-called 'thirst cure,' which has some good effect in the treatment of serous effusion; and the jaborandi cure. The first method consists in the withdrawal of fluid from the diet, which should be as dry as possible, and consist of lean cold meat, stale bread and the like. All fluids are forbidden, except half a pint on the third day, and a pint on the seventh and eighth days. The effusion is said under this method to decrease daily; the method, however, is more painful than tapping, and could not be borne by all patients without injury. The second plan consists in the promotion of profuse sweating, by means of jaborandi. Excellent results are said to have followed this method. The drug is administered as a liquid extract, ℥j being given every three hours. If medicinal and dietetic means fail to remove a moderate effusion, or if the effusion already occupy the whole or a great part of the pleural cavity, the cavity must be tapped without further delay. There should be no hesitation in tapping instantly any chest which is dull up to the clavicle, or which presents a small tympanitic space under the clavicle. The operation of removing fluid from the chest by tapping (paracentesis thoracis), seems to have been practised in early times, but has scarcely become familiar to us until the last quarter of a century. To Trousseau, of Paris, and to Dr. Bowditch, of Boston, the profession is chiefly indebted for anything like doctrine in this matter. Trousseau was probably the first physician to recognise the means, and the propriety of tapping in *serous* effusions.

2. *Paracentesis thoracis.*—Taking the operation as agreed upon, we will now lay down the precise method of it. It may be a matter of doubt whether the fluid contents of the chest be serous, sero-purulent, or purulent. To ascertain this a hypodermic syringe may be passed through the wall of the chest, and a sample of the fluid drawn away. In this way information is obtained as to the nature of the fluid, and its accessibility. Should the tap be dry, it can be repeated elsewhere more readily, and with less sense of failure, than the greater operation. The precise place of operation must, of course, be chosen with great care; but, happily, there is plenty of margin for error. In an encysted empyema with thickened walls four or five punctures may be needed before pus be reached. If the issue be purulent two openings will be needed, when, after choosing the second with the greatest care, the first may be closed; if the issue be serous, the complete emptying of the cavity is not necessary, and not always desirable. In cases of multilocular pleuritic effusion the emptying of one cavity only is of course an incomplete measure. Such cases are unsatisfactory

at best, and can only be tested by repeated puncture.

If there be no special reason to the contrary, the chest will be tapped on the lateral or posterior aspect, as there is thus less danger of interference with other organs. Reasons to the contrary may present themselves in the case of adhesions tying the lung to the side or back of the cavity, of lateral displacement of the heart in left-side effusions, of deformities in the individual, and so forth. The pointing of an empyema forward, however well-marked, is no indication for an anterior opening, as this pointing will recede when a posterior opening has been made; nor is the faintly audible sound of respiration over the back of the affected side a reason for declining to operate posteriorly, for, such faint sounds are often conveyed to the ear when the cavity is full of fluid. Let a minute scrutiny then be made of the lateral and posterior aspects of the chest. Let any bulging of intercostal spaces be looked for, as at such a spot false-membranes are probably scanty or thin, and let the ribs be minutely examined, in order to ascertain that there is room enough between them for the insertion of a finger into the cavity, if this prove to be needful; or that, in any case, resection of a rib may, if possible, be avoided. The axillary line should be chosen in all cases in which the effusion is believed to be serous. If it should appear that the fluid is so limited or encysted that it does not gravitate to the bottom of the cavity, a tentative puncture must be made at the dullest spot, regard being had of course, to the position of neighbouring organs. If there be no indication to the contrary, we shall select the fifth intercostal space, a little in front of the axillary line, as our point of entrance, or the fourth space on the right side.

The needle must now be gently forced through the skin, and then shot with a sharp sudden thrust through the remaining tissues into the cavity, the operator being careful to take the mid space, and thus to avoid the periosteum of either rib, and the intercostal artery. If the skin be thick it is well to incise it with a bistoury before inserting the needle. There is no objection to freezing the skin beforehand, but it is rarely desirable. If the fluid drawn be clearly serous, and the patient be a child, or, the syringe capacious, it may be well, if time press not, to wait a day or two to see whether this small draught will set up absorption of the rest. Many such cases are on record. As a rule, however, it will be needful to proceed to a further evacuation of the cavity. For this a special instrument will be needed.

We cannot enter into an account of the many instruments sold for paracentesis thoracis; almost any one of them is satisfactory. They all consist in a fine trochar or perforated lance-headed needle, with an exhausting apparatus attached thereto.[1] Pumps of various makes are therefore adapted to the trochars, by which the pressure of the atmosphere or the choking by clots may be counteracted. These pumps are rather cumbrous, and they are liable to be worked at an excessive pressure. The best exhaust in ordinary cases is a column of the fluid itself, which can be made longer or shorter, as the run of the fluid seems to indicate. This column is formed by attaching a long, fine india-rubber tube, at least four feet long, to the collar of the trochar, and its length is varied by elevation or subsidence of the basin of water in which its distal end is placed. This tube has, of course, the action of a syphon, and by it alone, in the vast majority of cases, we can overcome the resistance of the atmosphere. The diameter of the tube should be small, or the fine canulas now in use for paracentesis will not feed it; moreover, the slower the issue of the fluid the better. It is well to attach the tube to a short branch of the canula issuing at a small angle from the side of the latter, and containing a stopcock; in such an instrument the trochar works like a piston in the canula, and can only be withdrawn to a point immediately beyond the opening of the lateral channel. The advantage of this arrangement is that on stoppage of the canula the trochar can at once be so pushed up as to clear it. If there be no piston-trochar the canula has to be cleared by wires—a fidgety process, and too often inefficient. It may be better indeed under such circumstances to close the wound and reintroduce it elsewhere; thus less pain and annoyance is felt in the end, and a better result obtained. As inflammatory serous effusions are certainly liable to turn into pus if septic elements be admitted to them in the smallest quantity, the instruments used must be scrupulously disinfected and air excluded. If the distal end of the delivery tube be placed in water, and the tube be emptied by running the finger down it, any bubbling will almost certainly point to wound of the lung. The cock should be turned when the patient is quiet and at the beginning of his expiration. The fluid will run at first in a steady stream, afterwards in gushes corresponding to the inspirations. When the fluid ceases to run, or coughing grows troublesome, the tube may be withdrawn; for if the fluid be serous the presence of a remnant, or more than a remnant, of the effusion in the cavity is of no disadvantage; if it be seropurulent the cavity is certain to refill, and if it be laudable pus it will in all probability refill. On the other hand, when the lung expands imperfectly, to exercise strong suction upon the mediastinum or on the abnormally vascular pleura is to run the risk of doing harm. The patient must neither lie nor sit erect, but a semi-recumbent position should be taken, with the shoulders raised upon pillows. If there be any tendency to syncope, an erect position will favour it, and a recumbent position is unfavourable to operation and to escape of fluid. The patient must be closely watched, and the stopcock turned on the least sign of faintness, but, happily, this is rarely seen. Cases are reported in which sudden death has occurred during paracentesis, or about the time of it, but cases of sudden death are not uncommon in pleuritic effusion, whether punctured or not. An anæsthetic is scarcely required for simple paracentesis. If the edge of the canula present no

[1] The hollow needles sometimes used have many drawbacks. They may prick the lung and cause cough or even let air into the pleural cavity, which, though not septic, prevents expansion of the lung. This, though not the only one, is a sufficient objection.

harsh ridge upon the trochar the stab is but little painful.

It is well, if there be no indication to the contrary, to inject one-fifth of a grain of morphia beneath the skin after the operation, to relieve any irritation either by cough or otherwise, and to secure subsequent rest. The stopcock of the instrument will, of course, be shut when the trochar is withdrawn, and the puncture promptly closed on withdrawal by the finger. It is well to keep the finger in apposition for a few minutes, and then to apply a simple lint-pad with short strips of plaster. In favourable cases no second tapping is needed, and the heart tends to recover its position on the completion of the operation, moving three inches perhaps in the course of it; in other cases, even of serous effusion, the severity of the pleurisy may have so fettered the lung that the readjustment of the parts is much more gradual, and the space of the effusion is reoccupied but slowly by the unfolding lung and the yielding of the chest-wall and mediastinum. In this respect there is not much difference between serous and purulent formations, save, of course, that neglected cases are more likely to have become purulent. A rapid return to the normal of the physical signs is a very good omen, and in cases promptly dealt with is now happily our common experience. In cases which recover more slowly we get less help from the physical signs, the conditions within the chest being in a more stable state of perversion. In pleuro-pneumonia the lung may not be able to expand any more in cases of paracentesis for the pleurisy, so that only some ten ounces or so may be obtainable by falling in of the ribs. In two cases in which the present writer noted reduplication of the second cardiac sound before tapping, this sign ceased at once on the emptying of the cavity. It is rather the rule than the exception for some dulness to remain below the scapula, and this alone is no indication for repeating the operation.

If there be any subsequent pain or elevation of temperature, these, under ordinary circumstances, will prove to be transient. If the rise of temperature continue after the first day or two, the formation of pus is to be feared. The formation of pus, moreover, is not infrequently attended with a re-awakening of pain. If pus form, the cavity in all likelihood will soon refill, and pus will be detected on puncture. It is desirable, however, to draw off a considerable quantity of a purulent effusion by ordinary tapping before proceeding to any further operation, as in this way any danger due to the sudden emptying of the whole cavity by the radical operation is avoided. Soon after, or in one or two days, according to the state of the patient, an opening must be made sufficiently large to permit of the introduction of a sound. By means of the sound the extent and depth of the cavity will be gauged, and the sound being directed to the lowest point in the axillary or infra-scapular line an opening must be made upon it into the cavity, through which the latter will be drained to the last drop. It is impossible to take too much pains to secure the perfect freedom of this opening, or to place it at the lowest point in the cavity. For this reason it is desirable to give an anæsthetic, that the operation may be deliberately performed. Chloroform seems to put less strain upon the limited breathing powers than ether in these cases. If the patient be of spare body, let the opening be taken below the spine of the scapula; if stout and muscular, a more lateral operation will probably be preferred, though drainage is more continuous and thorough by a posterior opening, and the ribs are there less liable to fall together. After the pus has run out, the upper opening may be closed in the usual way. On no account let a drainage-tube be run through both openings, or it will act as a seton.

It is of the greatest possible importance that all the instruments in use be disinfected, and it is desirable, if possible, to do the whole operation and dressings by the antiseptic method; and this is to be followed up by dressing under the spray. From the time of the operation, it has been stated, the temperature will fall rapidly to the normal; if it rise again during convalescence the rise will be almost surely due to occlusion of the opening. To prevent this we insert a drainage-tube. False-membranes as thick as wash-leather may oppose themselves at first, and the tube therefore, at first, should be proportionately large; but these soon break down into curdy shreds, and the tube may be reduced in diameter, and must be gradually cut away, as secretion of pus diminishes. Injections of a simple or antiseptic character, into the cavity of empyema, are in the writer's opinion to be avoided. They are rarely of use, they often increase irritation, and are sometimes attended with distressing or alarming general symptoms. The great secret is to secure free and complete drainage; if this be attained the cavity will purify itself. This is as true of closing cavities as of freshly-opened cavities; for to inject sinuses, in the hope of procuring adhesion and closure, rarely succeeds and often does harm. In like manner to probe the opening of an empyema is generally a mistake. If the opening discharge for a long period, it may be well once for all to ascertain the length and direction of the sinus, but it is better to enlarge the opening if necessary, or even to make another, than to fret the part by repeated explorations. Resection of a portion of a rib has been recommended by some surgeons, even as a part of the ordinary operation. If a neglected empyema have shrunk or discharged spontaneously, or if, after opening, the continuance of the discharge seem to depend on rigidity of the chest-wall and arrest of lung, then resection of a considerable portion of two or three ribs may carefully be considered. In this way closure of the cavity may be obtained, the spine and shoulders becoming distorted; but such cases will become very rare as diagnosis and early operative relief are more generally understood.

In the exudations of tuberculous or carcinomatous disease, operation is often more than justified by the temporary relief given to the sufferer. If after the removal of a collection of pus and the establishment of free drainage the discharge becomes more offensive and the fever remains, the disease is probably tubercular and the forecast of the worst.

Sometimes empyemas have been treated by repeated aspirations, instead of by incision and continuous drainage. It is hopeless to attempt the cure of a sero-purulent discharge by this method, but a collection of laudable pus once removed by the aspirator has in rare cases failed to return. The chance of success by this method is too slight to be looked for with any confidence, and the repetition of these aspirations does not prevent the gradual condensation of the lung, nor the formation of a pulmonary fistula. There is no difference in method between the performances of these operations in childhood and in age, but in childhood recovery is generally more rapid and sure. Nor is there any difference of method in operating upon a case in which a pulmonary or other ill-placed fistula has already formed, nor is the performance of the operation much the less urgent in such cases, even if the bronchial opening be free and not valvular.

It is desirable that after each or any removal of fluid from the chest the re-expansion be assisted by respiratory gymnastics. The best method of obtaining this end is by graduated exercise; by the inhalation of compressed air from one of the apparatus constructed for this purpose; or by residence at high elevations.

Means have been proposed by which the entrance of air into an empyematous cavity under drainage might be prevented, and the lung thus helped to expand under inspiration. The permanent need of absolute freedom in draining and dressing, however, must discourage the use of all complex apparatus, and if the operation be performed early and antiseptically it is marvellous how well the lung will recover itself.

3. **Pleura, Air in.**—Synon.: Pneumothorax; Fr. *Pneumothorax*; Ger. *Luftbrust.*

Definition.—Pneumothorax, as its name imports, is the state in which the pleural cavity, normally vacuous, or rather non-existent as a space, contains air or other gas without intermixture of liquid. If air or gas be present, together with pus, blood, or a watery fluid, we give to the resulting state the compound names *Pyopneumothorax*, *Hæmatopneumothorax*, and *Hydropneumothorax* respectively. The gaseous contents in these cases may precede the entry of the fluid or succeed it, and in the latter case it may perhaps be developed as a product of decomposition. These conditions, though not wholly unknown to the predecessors of Laennec, nevertheless were first adequately distinguished and clinically demonstrated by him.

Ætiology.—Pneumothorax is a commoner event than would be supposed, were we to confine our attention to the cases which have received this name. It is often an incident in the course of other diseases, and of none more often than phthisis. Pneumothorax sometimes, but rarely, appears as a primary event and disappears again without further complication; more usually it occurs as one result of wounds of the chest, of purulent pleuritis, of phthisis, or of some rarer disease, such as ulceration of the œsophagus or stomach, carcinoma and the like, which effects an opening into the cavity. If air be mechanically admitted to the cavity, decomposition of its contents may add to the volume of that which was admitted. Even in those few cases in which pneumothorax seems 'idiopathic'—in which, that is, we find pneumothorax to be the first, the sole, and the last morbid state—we are almost bound to assume that this state is, in fact, secondary, and due to some perforation the cause and place of which escape our search. That such cases do occur is unquestionable; the most frequent cause being a strain, noticed or unnoticed at the moment. In passing to the cases of more obvious causation, those due to wounds of the chest are the first to meet us, and need not detain us. That any wound perforating the wall of the chest and the pleura will permit air to be drawn by suction into the pleural cavity is obvious.

Of the same kind, but of natural origin, is the pneumothorax which in empyema follows perforation of the lung with ejection of the pus upwards, or perforation of the chest-wall by natural ulceration outwards. In these cases of pyopneumothorax we have to deal, of course, with the presence both of pus and of air in the pleura. Pneumothorax, though occurring but in a minority even of the ulcerative cases of phthisis, yet is frequently met with as a complication. It occurs for the most part in the later stages of the disease, and often escapes observation; less frequently it is met with in the earlier stages, and is then betrayed at once by its symptoms. Its occurrence may be aided or not by such a strain as a fit of coughing. That pneumothorax is not a more uniform result of ulcerative processes in the lung is due, of course, to the anticipation of a breach of surface by previous adhesive inflammation. In phthisis, happily, the perforation as a rule is minute, and the quantity of matter escaping into the cavity small—so small as to be generally inadequate to produce the physical signs of fluid contents. In other cases the escape is more abundant, or a more abundant effusion comes from the pleura itself, as a consequence of the resulting irritation. We then have to deal with an obvious hydropneumothorax, or pyopneumothorax. The opening by which air escapes into the pleural cavity may be, and often is, valvular, so that its entry during inspiration may not be balanced by its exit. In this way air may accumulate under pressure. If, as in empyema, the lung be already collapsed, this pressure is the less distressing; if the lung be wholly or in part open, the pressure adds to the degree of the sudden embarrassment due to rapid collapse of lung, and to encroachment upon the surrounding parts, including the opposite lung. Air thus entering the pleural cavity is often purified from septic elements by its filtration through the lung, unless it pass through cavities and alveoli already charged with septic matters. In puncturing the chest-wall with a fine trochar, in cases of serous effusion, the lung is sometimes wounded, and air escapes into the pleura. The accident is an untoward one; but the air which thus escapes into the pleura is so cleansed by its passage through a healthy lung that, as a rule, it sets up no putrefaction, and is itself quickly absorbed. The puncture heals too rapidly to permit of any continuous transpiration, but the quantity suddenly admitted may add a good deal to the suffocative distress of the

patient. A similar state of things is not uncommonly seen in the practice of the surgeon, when an injury which breaks a rib also drives its broken point or points through the costal and pulmonary pleuræ.

It is said that in emphysema the bursting of dilated lobules may set up pneumothorax, and we may wonder that this event should be so rare. Perforation into the pleural cavity by cancerous or other destructive changes, either in the lung itself or such neighbouring organs as the œsophagus, the stomach, the bowel or connected ducts, is not very rare in cases of malignant disease; and the entry of air and food into the pleura sets up suffocative and inflammatory symptoms, which add greatly to the miseries of the last days of life. There are, no doubt, other ways of disease by which air may find its way into the pleural cavity; but the above description, with little or no essential difference, will apply to all.

Anatomical Characters.—Under this head we have little to say in respect of pneumothorax, and we have not here to deal with the further appearances of hydrothorax or empyema. A patient would rarely die of simple pneumothorax; for if death be mainly due to this, yet unless it occurred within the first few days it is probable that some degree of inflammation would follow the disturbance. In the vast majority of cases, of course, the pneumothorax is secondary to some other disease, and any fluid or other products found with the air in the chest may be due—not to the mere admission of septic air into the cavity, but to the admission of decomposing tissue-elements into it. As concerns the presence of air alone, we have only to say that in most cases—especially in the cases in which air has reached the pleura by a valvular opening—the affected side of the chest may be visibly distended. In such a chest the pressure of the contained air may well have been not passive only but active, and on puncture the imprisoned air may escape with a hissing noise; if the lung be wholly retracted, and the air contained under high pressure, the out-rush may be very strong—strong enough to blow out a candle. This air is usually deoxidised, and rich in carbonic acid; if there be decomposing matters in the cavity, it is likely also to contain sulphuretted hydrogen. Neighbouring parts will be found more or less dislocated directly as the degree of compression of the contained air, and inversely as the amount of adhesion limiting its extent. Bilateral pneumothorax is, of course, incompatible with life; if it be found double we may be sure that one side of it came on at the moment of death.

Symptoms.—The symptoms of pneumothorax are of course the more distinct, the less the symptoms of the primary malady. In those rare cases in which pneumothorax comes on apparently as a primary disease—that is, in which the mode of entrance of air into the pleural cavity is most obscure—we find the chief symptoms to be dyspnœa and a sense of faintness, pain being a less uniform symptom, and present only when the entrance of air is followed by irritation and inflammation from the fluid or solid matters which accompany the gaseous. Aseptic air alone does not set up inflammation, nor much irritation. Fever, in like manner, depends not upon the entrance of air, but of the irritating matters accompanying the air, and exciting inflammation. It may, like the pain, be considerable; it may not be present at all; or, again, it may be lost in the fever of the primary malady, or show itself as a slight exacerbation of that fever. The dyspnœa, in part mechanical, in part probably reflex, is necessarily attended by increase of pulse-rate; the two events being but different aspects of the same machinery. The degree of these accelerations, as has been hinted, depends upon the amount of previous accommodation in the chest, and upon the amount, if any, of fluid and solid concurring with the gaseous escape. The escape of air with irritating matters suddenly into the pleural cavity of a person suffering but little from a phthisical ulceration, or of one surprised by an accident in the midst of health, will cause dyspnœa almost suffocative in degree, faintness, great acceleration of the pulse, and intense pain. If the affair be more serious there may also be symptoms of collapse, including a fall of temperature, cold extremities, ashen face, colliquative sweats and chill breath. On the other hand, in pneumothorax occurring towards the end of phthisis, when a pulmonary ulcer breaks into the pleura widely-adherent about a lung already half-obliterated, an attack of chest-pain may follow a bad fit of coughing, and be often put down, like the dyspnœa and the pulse-rate, to the fatigues and distress of a restless night. The patient's general condition is not very markedly altered in such cases, and the pneumothorax is often overlooked. Cough and expectoration of course assume no proportions in simple pneumothorax; but if pneumothorax be established on the bursting of an empyema into a bronchus, it is obvious that cough and expectoration will be the most prominent of the symptoms. It is well to remind the reader that emphysema of the skin may result from the same breach which causes the pneumothorax.

The *physical signs* are as follows:—The affected side, in well-marked cases, may be enlarged in girth and of a rounder form. It is, moreover, still in respiration, the half of the chest being fixed in the inspiratory position, or only dragged a little by the efforts of the accessory muscles. Air, like fluid, may press down the diaphragm, thrust the mediastinum aside, and change the place of the heart. And even if the admission of air be not through a valvular opening, and the admitted air be passive, yet, as Dr. Douglas Powell has shown, the elasticity of the opposite lung will dislocate the parts to some extent. In other cases, as in pyopneumothorax with retraction the affected side often falls in so as to be of less girth than the sound side. In such a case, of course, there is no tension of the contained air. Vocal fremitus must be absent if the lung be wholly collapsed, or far removed from the wall of the chest; if the lung be adherent in part to the chest-wall, vocal fremitus may be proportionally perceptible, and it may be possible to ascertain by other methods how far, if at all, the lung is adherent. Decubitus is usually on the affected side.

Percussion gives us great assistance in the

detection of pneumothorax, the sound being tympanitic everywhere where lung is not, by adhesion or repression, kept in contact with the chest-wall, and often extending beyond the normal boundaries of the affected side. There is something about the loud, low-pitched and extensive (tympanitic) vibrations of the stricken chest in pneumothorax which is very characteristic. On the other hand, it is said that if the pleura be tightly distended by air under high pressure the percussion note may rise to positive dulness, and the presence of fluid will dull the percussion considerably or altogether, in districts which will vary with the quantity of fluid and the position of the patient. In pyopneumothorax, with a bronchial fistula, the sharp line between hyper-resonance and dulness may be changed after a profuse expectoration. By percussion with palpation the dislocation of neighbouring parts and organs may be ascertained. The auscultatory phenomena of pneumothorax are curious, and were known even to Hippocrates. If we confine ourselves to pneumothorax pure and simple, auscultation is generally almost negative; in rare cases we may detect by a blowing sound the entrance and exit of air by a free opening, but in such cases fluid is always present as well. In them there may be faint amphoric breathing and a few resonant *râles*, especially near the shoulder-blade. The voice sounds in like manner; and the cough may be more or less amphoric. Vesicular breathing is never heard. In pneumothorax, there is often present the peculiar phenomenon called the *metallic ring*. After death this metallic echo is always to be obtained, but during life the increased tension of the gas at the higher temperature may prevent it. In addition to this a very clear cracked-pot sound may be heard in some cases of pyopneumothorax with a wide fistula. The metallic tinkle of succussion, which was known to Hippocrates, consists in the echo of splashing or dripping fluid in the air-containing pleural cavity; and indeed other sounds generated inside the patient, such as the heart-beat, cough, &c., may take this metallic resonance from the chest-cavity, and may betray pneumothorax or illustrate it. In the same case, at different times, such sounds may be heard, or may be inaudible—changes which are, perhaps, due either to mechanical conditions dependent upon adhesions, the formation of false-membranes, the shape of the cavity, or the tension of the contained gases. *See* PHYSICAL EXAMINATION.

DIAGNOSIS.—The diagnosis of pneumothorax by the signs and symptoms above named is not difficult, if the occurrence of it be sudden and the patient not too ill to resent examination. If the presence of adhesions prevent the development of these symptoms, the case may be more obscure, but by so much the less serious. As, on the one hand, in an enormous moist cavity it is conceivable that metallic and succussion sounds may be heard, so, on the other hand, pyopneumothorax, restricted by adhesions to small dimensions, might simulate a cavity. Indeed, diagnosis might be impossible in such cases, but speaking generally, the dulness and retraction of the chest-wall over a cavity would assist the diagnosis. Distension of the stomach, with elevation of the diaphragm, or diaphragmatic hernia, could scarcely be mistaken for pneumothorax by anyone who fairly took into consideration all the facts and history of the case. As empyema, especially in children, is liable to lead to purulent pericarditis, so may pyopneumothorax by perforative process have pyopneumopericardium added to it. Emphysema of the lungs gives rise to tympany sometimes as great as of pneumothorax. Emphysema, however, is always two-sided, and rarely dissociated from sibilus or other sign of open bronchial tubes. In cases of pyo- or sero-pneumothorax there may be great difficulty in determining the quantities of fluid and of gas respectively in the cavity; as much as three quarts of fluid may co-exist with a great deal of resonance above it. Tapping alone could decide the matter, and in such a case would probably be indicated.

PROGNOSIS.—This obviously depends so largely upon the causes and concomitants of the pneumothorax, that any general estimate of it is impossible. The tendency of air in the pleura is to absorption. The prognosis of chest-wounds, of phthisis, of empyema, contains differences too wide for formulation. It is asserted that pneumothorax, by the sudden oppression of the lung, through the in-rushing air, may cause rapid and even sudden death.

TREATMENT.—The treatment of pneumothorax in like manner must depend greatly upon the nature of the primary malady. In pyopneumothorax from empyema operation is the first necessity in a patient of sound constitution. Whether in any given case of phthisis pyopneumothorax should be dealt with by operation may become a question—but a question usually, of course, to be decided in the negative. In such cases opiates alone are our resource. Still, a case may be imagined in which the urgency of operation may outweigh its risks. In wounds of the chest-wall, or of the pulmonary pleura, the puncture rarely closes so soon as to imprison the air in a state of higher tension than the atmosphere. Such a thing may occur, however, and the displacement of organs and respiratory distress may indicate that relief is urgently needed. If it be, a fine trochar may be inserted into the chest, and by means of a tube air may be permitted to escape through water until equilibrium is re-established. The hypodermic use of morphia is as valuable in soothing the pain and distress of pneumothorax as of like suffering elsewhere. Walshe recommends general bleeding, if admissible, or in any case free dry-cupping of the affected side. Among drugs he chiefly recommends musk, in five-grain doses, and very small inhalations of chloroform.

4. **Pleura, Dropsy of.**—SYNON.: Hydrothorax; Fr. *Hydrothorax*; Ger. *Brustwassersucht.*

DEFINITION.—As the word implies, this is the term given to simple aqueous effusions into the thoracic cavity.

DESCRIPTION.—Hydrothorax is not to be classed with the effects of inflammation, but with dropsies elsewhere, and is the companion in many cases of ascites and anasarca. In other cases it exists alone, but is rarely confined to one side of the thorax, and perhaps never exists as a sole malady. We may say generally that it is liable

to arise under the following circumstances:—when the whole circulation is so impeded that venous pressure is increased—as, for instance, in disease of the mitral valve or its orifice; when venous arrest is due to some local causes, as for instance, to the pressure of localised swellings upon veins, or to venous thrombosis; when the bronchial glands are enlarged; when in renal disease the removal of water from the system is checked; or, finally, when the quality of the whole blood is so deteriorated by disease, or the circulation is so changed by cold, or other such general influence, that its serum tends to exude passively from the vessels. In the first and third cases we should expect to find dropsy in both pleural cavities, in the second case the transudation might be limited to one of them. On the other hand it is to be remarked that such transudations rarely stand at the same height in the two cavities, and indeed the contents of one of them is often so small in volume that the hydrothorax may seem to be unilateral. As a matter of experience hydrothorax is chiefly seen in diseases of the heart and kidneys, in scarlet fever, in septic and other diseases of the blood, and in the cancerous and other cachexias, whether there be local disease of the pleura or not.

Diagnosis.—The diagnosis of hydrothorax and its measure are easy, except in a few cases where the effusions are restrained by adhesions. The lung floats more readily than in pleuritic effusion, and the diaphragm often retains its normal relations.

Treatment.—Hydrothorax in the majority of cases is not formidable in itself, and (being not uncommonly an event of the last days of life) is perhaps only noticed at the autopsy. Diuretics and hydragogue purgatives act more readily in hydrothorax than in inflammatory serous effusions. Still, if it increase so far as to harass the breathing or to add to the dangers of the disease, the fluid may be drawn away by a fine trochar without any fear of purulent change. It is well, however, to prevent the entrance of air into the chest, lest the fluid have in any degree an inflammatory nature, as it may well have in scarlatina or nephritis, for instance. The operation may be repeated a great number of times if re-accumulations make it necessary. The fluid, if wholly non-inflammatory, will appear as a greenish or yellowish transparent water, containing no clots nor coagulating in the vessel; it will not contain corpuscular elements. The presence of a corpuscular precipitate, or any troubling of the fluid, will at once suggest a degree of pleuritis. In heart-disease with much venous stasis the effusion is not rarely tinged with blood. If there be coagulation, however, the effusion is probably inflammatory.

5. **Pleura, Hæmorrhage into.**—Synon.: *Hæmothorax.*—Bloodstained effusions may occur, as we have said, even in simple pleurisy, but more commonly in such conditions as scurvy, tubercle, cancers, and the like. A purely sanguineous effusion is generally the result of wounds of the chest or its viscera; but it may also arise from within, as from rupture of the heart or of an aneurism, or from a bleeding cancer. The means of examination or treatment of such cases, in so far as these are possible, may be gathered from the preceding sections. Hæmorrhage into the pleura from direct extravasation may be left awhile, on the chance of reabsorption. If this does not seem on the way, a tentative puncture may be made. If the issue be ichorous, the patient will probably become febrile, and the major operation be needed sooner or later.

6. **Pleura, Morbid Growths in.**—The pleura enjoys no complete freedom from the invasion of sarcomatous or carcinomatous growths; but the former class of growths are very rare, except as intrusions from neighbouring parts. Cancer is found less rarely. The frequency of mammary cancer and the neighbourhood of the pleura to the breasts increases the danger of secondary mischief in the former part. Pleural mischief is, indeed, a common consequence of mammary cancer, and may be the fatal conclusion of a case. It occurs after or before operations of excision. From the cancer in the wall of the chest simple inflammation often extends to the pleura, and produces the usual results. In other cases the cancerous growth is itself propagated to the costal pleura, and spreads from thence. The cancer is usually seen in the form of small flattened or rounded elevations, rich in blood-vessels. If septic matters escape into the pleural cavity its effusions may soon become putrid. It is said that a rapid degeneration of cells, either cancerous or tubercular, may give rise to a quantity of fat-droplets so great that a layer of fat may be seen to stand on the top of the serosity withdrawn by tapping. Blood, too, easily issues from highly vascular formations—whether cancerous, tubercular, or simply inflammatory; and may be seen in the fluids after withdrawal.

There is little to be said of the symptoms and signs of such cases that has not been said already under the more general heads of Lungs, Morbid Growths in; Mediastinum, Diseases of; and Pleurisy. The diagnosis of cancerous or other such masses from their own effusions or from simple effusions, let it be frankly repeated, is sometimes impossible without the needle. The prognosis in such cases will not depend upon the pleuritic changes alone; and the only remark to be made on their treatment is that paracentesis, in the secondary effusions, is not wholly to be declined. Some such patients have obtained from repeated puncture not only a prolongation of life, but also great relief of suffering.

T. Clifford Allbutt.

**PLEURODYNIA** (πλευρὰ, the side, and ὀδύνη, pain).—Synon.: Intercostal myalgia; Fr. *Pleurodynie*; Ger. *Seitenschmerz.*—A name for muscular rheumatism or cramp affecting the chest-wall. *See* Cramp; and Rheumatism, Muscular.

**PLEURO-PNEUMONIA.**—This compound word signifies a combination of inflammation of the pleura and of the lung itself. In all cases of acute pneumonia there is a certain degree of pleurisy corresponding to the inflamed lung; but it is of little or no practical significance, there being only some exudation on the pleural surfaces. Pleuro-pneumonia implies that the

two morbid conditions are actually associated in various degrees, giving rise to their respective pathological changes, and each thus influencing the symptoms and physical signs. Individual cases, therefore, present many diversities, in accordance with the different ways and degrees in which the two diseases are combined. It may happen that they are associated from the first; or one may supervene during the progress of the other, in this way modifying its course, and not uncommonly rendering the diagnosis more or less obscure and difficult. It may be affirmed that the exact conditions present in the chest under such circumstances can only be positively determined by adequate physical examination; and it must be remembered that the pleuritic and pulmonary conditions will each tend to modify the signs produced by the other. No general rules can be laid down as to prognosis or treatment, but every case must be regarded on its own merits, in accordance with the principles laid down in the articles which treat of pneumonia and pleurisy respectively. *See* Lungs, Diseases of; and Pleura, Diseases of.

Frederick T. Roberts.

**PLEUROTHOTONOS** (*πλευρόθεν*, laterally, and *τόνος*, tension).—A form of tetanic spasm, in which the body is bent towards one side. *See* Tetanus.

**PLICA POLONICA** (base Latin).—Synon.: Fr. *la Plique*; Ger. *Weichselzopf*.—An alteration in the direction of the hair, attended with matting or felting, and resulting from neglect. *See* Hair, Diseases of.

**PLOMBIÈRES, in France.**—Simple thermal waters. *See* Mineral Waters.

**PNEUMATOCELE** (*πνεύμων*, the lung, and *κήλη*, a tumour).—Hernia of the lung. *See* Lungs, Malpositions of.

**PNEUMOGASTRIC NERVE, Diseases of.**—Synon.: Fr. *Maladies du Nerf Pneumogastrique*; Ger. *Krankheiten des Vagus*.—Of all the cranial nerves, the pneumogastric has the most extensive distribution, supplying the pharynx, larynx, lungs, heart, œsophagus, and stomach, and even, in part, the intestines and the spleen. In some of the so-called functional diseases of the organs which it supplies, its action is conspicuously deranged. The symptoms of its disease are thus very extensive, and it will be well first to describe them generally, and afterwards to consider in detail those which merit separate description.

Some of the functions of the vagus depend upon fibres of the spinal accessory which join it, but it is convenient to consider these in this article.

The pneumogastric, it will be remembered, arises from the side of the medulla, between the glosso-pharyngeal above, and the spinal accessory below, and to the outer side of the hypoglossal. The fibres of origin come from a tract of grey matter which is continuous below with the nucleus of the spinal accessory, and above lies, in the calamus scriptorius, between the hypoglossal and internal auditory nuclei, while to the outer side of the upper extremity, and more deeply seated, is the nucleus of the glosso-pharyngeal. The trunk of the nerve, after receiving fibres from the spinal accessory, and giving off some small branches (of which the most important is one to the external ear), passes down the neck, behind, and in the same sheath with, the carotid artery; enters the thorax on the right side, over the subclavian artery, and, on the left, between the subclavian and the carotid; passes through the thorax beside the œsophagus; and ends in branches to the stomach, spleen, and intestines. The most important branches are the pharyngeal, which, with the glosso-pharyngeal, forms the plexus of the same name; the superior laryngeal; the recurrent laryngeal, which passes back, the left around the arch of the aorta, the right around the subclavian artery; branches to the œsophagus; pulmonary branches which, by means of the pulmonary plexus, supply the lung; and branches which form the cardiac plexus for the heart.

Ætiology.—The deep position of the pneumogastric and its branches preserves it from some forms of damage, although its extensive course renders it liable to suffer from many causes. The nucleus in the medulla may be damaged by local softening, hæmorrhage, or slow degeneration; but in all these cases other, adjacent, nuclei suffer (*see* Labio-glosso-laryngeal Paralysis). The nerve, at its origin from the medulla, may be compressed by thickening of the meninges, growths from the meninges or bones, or aneurism of the vertebral artery. Affections of the nerve due to syphilis are almost always the result of meningeal disease in this situation. Other adjacent nerves commonly suffer at the same time. The trunk of the nerve is sometimes, but rarely, implicated in punctured or gunshot wounds; incised and lacerated wounds damaging it are usually immediately fatal from lesion of the large blood-vessels to which it is contiguous. In surgical operations the trunk and branches of the nerve are occasionally injured. The trunk has been tied in ligature of the carotid, and divided in the removal of deep-seated tumours. In such operations in the lower part of the neck it is often also difficult to avoid injury to the recurrent laryngeal. In excision of an enlarged thyroid both recurrent laryngeals have been repeatedly excised, from the time of Galen down to the present. Sarcomatous and other tumours, and enlarged glands, may compress or involve the nerve in almost any part of its course; and interference with its function especially occurs from such disease in regions limited by rigid structures, as in the upper part of the neck, near the skull, and in the upper part of the thorax. Aneurisms may compress the nerve or its branches; and the recurrent laryngeals suffer from this cause with especial frequency, because they pass round large blood-vessels. The left suffers much more frequently than the right, because the arch of the aorta is more frequently affected by aneurism than the subclavian. An enlarged thyroid may compress the recurrent laryngeal nerves, and symptoms due to such compression may vary with the varying size of the tumour. The nerve is, in rare cases, the seat of neuromata. Neuritis of the trunk of the nerve, due to cold, is supposed to be an occasional cause of symptoms, but such cases are extremely rare.

Some toxic influences, and especially the poisons of diphtheria and lead, may affect it, probably by acting on its central origin.

Symptoms.—It must be remembered that the vagus nerve, besides containing motor fibres for the pharynx and larynx, is the chief afferent nerve for the respiratory centre. It contains accelerating and inhibitory fibres for this centre, but the former preponderate, so that experimental division of the nerve in an animal renders the respirations less frequent, but deeper, while stimulation of the divided (central) end quickens the respiration, and may even arrest it in tetanic standstill. The inhibitory fibres are contained chiefly in the superior laryngeal nerve, and their stimulation arrests the respiration in muscular relaxation. It is the inhibitory nerve of the heart; slight stimulation increasing the diastolic periods, and stronger stimulation arresting the action of that organ. On division of the nerve the cardiac contractions are accelerated. It has been said to contain trophic fibres for the heart and lungs, but this is not certain. The pneumogastric is an afferent nerve for the vaso-motor centre, the action of which is lowered by its stimulation, so that the arteries throughout the body are relaxed. It is the motor and sensory nerve for the œsophagus; the sensory nerve for the stomach; and partly also the motor nerve for the stomach and intestines.

Symptoms due to paralysis of the vagus are more frequently met with than those which result from its irritation. Occasionally both are combined. Laryngeal spasm and vomiting are the irritative symptoms most commonly met with, but occasionally cardiac inhibition occurs. Czermak, for instance, was able to arrest his heart for a few beats at will, by pressing a small tumour of the neck against his pneumogastric. Concato had a patient in whom a similar inhibition could be caused by pressure on the right nerve. The increased frequency of pulse which corresponds to its paralysis has been several times noted, and has occasionally been associated with diminished frequency of respiration, although the laryngeal paralysis, also resulting, has often obscured the effect on the respiratory movements. Roux tied the trunk of the vagus with the left carotid; instantly respiration was arrested, but the pulse was also retarded. The ligature was immediately relaxed, but the patient died in half an hour. Robert also tied the nerve with the carotid; the patient, who was conscious, immediately called out, 'I am suffocated!' and his voice became hoarse. He recovered, but the hoarseness continued for six months. A good example of interference with the functions of the vagus has been recorded by Guttmann. A lad, after diphtheria, presented paralysis of the palate and of one sternomastoid. His respiration quickly became reduced to twelve per minute, and very laboured, while his pulse rose to 120, and he died in a few hours. In many other cases a similar change in the pulse and respiration has been noted, and even a pulse-ratio of 160–200. In the face of these observations, and of experiments on animals, it is not easy to understand a fact said to have been observed by Billroth, who excised half an inch of one pneumogastric, which was implicated in a tumour, without any resulting symptoms.

The important central relations of the vagus above alluded to cause derangement of its function to form part of many so-called functional disorders of the central nervous system. Its nucleus forms part of, or is connected with, the respiratory centre, which is conspicuously disturbed in hydrophobia and some other diseases. The phenomena of 'Cheyne-Stokes breathing,' or 'respiration of ascending and descending rhythm,' are probably the result of lowered action of the respiratory or pneumogastric centre (*see* Respiration, Disorders of). This symptom is met with in cerebral hæmorrhage, uræmia, meningitis, and in some cardiac diseases. The central connections of the vagus, in the hemispheres, extend to, or are connected with, those parts which are concerned in emotion, and it is probably through the agency of this nerve that the heart's action is affected in excitement and fear. In many epileptic fits the central representations of the nerve are the parts through which the consciousness is first affected, and hence the so-called 'epigastric aura.'

A similar disturbance seems to be the cause of the globus hystericus and of the laryngeal spasm, which are conspicuous in some epileptic and hysteroid seizures. The nerve is closely connected with the centre or nerves for equilibration, so that severe vertigo, on whatever dependent, is often followed by vomiting. The pneumogastric nucleus is contiguous to the internal auditory nucleus, and part of the auditory nerve, that which comes from the semicircular canals (the space-nerve of Cyon) is known to be concerned in equilibration. In the vertigo which results from disease of this nerve, or of the canals (labyrinthine or auditory vertigo) vomiting is very common, and the nausea and retching of sea-sickness are probably due to the deranged action of the semicircular canals, in consequence of the motion affecting the pneumogastric centre. It is possible that the connection of the vagus with the equilibrial nerves is by means of the cerebellum, disease of which so constantly causes vomiting, although this connection has not yet been traced. Conversely, gastric disturbance of the vagus is often accompanied by vertigo, especially when combined with pre-existent imperfect action of the auditory nerve.

1. **Pharyngeal Branches.**—The branches of the pneumogastric which enter the pharyngeal plexus supply the constrictors of the pharynx and the soft palate. Some have asserted that all the pharyngeal branches are derived from the spinal accessory; the pathological evidence that the branches to the soft palate are derived from this source is very strong, since when one vocal cord is paralysed from disease of the roots of the spinal accessory, the levator palati on the same side is always paralysed, and very often the tongue. *See* Palate, Paralysis of.

(1) *Paralysis.*—Ætiology.—The most common cause of paralysis of the pharynx is disease of the origin of the nerve in the medulla; such disease commonly also involves adjacent nuclei (*see* Labio-glosso-laryngeal Paralysis). Paralysis may, however, result from meningeal disease outside the medulla, from disease of the bones of the base of the skull, but scarcely ever from disease outside the skull. It occasionally forms part of diphtheritic paralysis.

Symptoms.—The chief symptom is difficulty in swallowing. Food lodges in the pharynx about the epiglottis, and small particles and liquids may enter the larynx. If the paralysis is limited to the superior constrictor, liquids may, it is said, be forced up into the nose by the contraction of the middle constrictor; but it is doubtful whether this occurs unless the palate also is paralysed. The affection of one nerve causes only slight trouble in deglutition, no doubt because of the circular arrangement of the muscular fibres.

Diagnosis.—The only conditions with which paralysis of the pharynx can be confounded are spasm and organic disease. The writer once saw an elderly man with distinct pharyngeal paralysis, who had been sent to an eminent surgeon because the difficulty in swallowing was supposed to indicate cancer of the throat. A careful examination is usually sufficient for the distinction.

(2) *Spasm.*— Spasm of the pharynx may be recognised by its paroxysmal character, and is almost always part of 'functional' nervous disease. It forms part of the spasm of hydrophobia; and occurs in hysteria, and in some other allied states. Individuals are sometimes met with who are unable to take food except when alone, so great is the amount of pharyngeal spasm which the presence of others induces.

2. **Laryngeal Branches.**—It will be remembered that, of the two laryngeal nerves, the superior is the sensory nerve for the larynx, and also supplies motor power to the crico-thyroid muscle, which is the tensor of the cords; while the recurrent laryngeal is purely motor, and supplies the other muscles. The motor fibres of both are derived from the spinal accessory. Of the muscles, the most important in regard to paralysis are the chief abductor, the posterior crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage backwards, and so moves the processus vocalis outwards); the chief adductor, the lateral crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage outwards, and thus the processus vocalis inwards); and the arytænoideus (which approximates the two arytenoid cartilages). Other muscles, acting at the same time, increase the power of closure.

(1) *Paralysis.*—Only paralysis of the abductors and adductors need be discussed in this article. That of the tensors and laxors of the vocal cords, although very important among laryngeal diseases, is always the result of local conditions, not of lesions of the pneumogastric nerve.

Ætiology.—Almost all diseases of the nerve-trunk affect the fibres to the larynx, the only exception being the diseases of the trunk below the origin of the recurrent laryngeal. Syphilitic and other intracranial disease, injuries, and pressure by tumours, all have this consequence; and the motor paralysis is, necessarily, almost as complete in disease of the recurrent laryngeal as in that of any part of the trunk of the pneumogastric. In diphtheria the larynx is also sometimes paralysed. Rheumatic paralysis is probably always local. Diseases affecting the fibres of origin of the spinal accessory at the medulla, or its trunk in the neck, or the recurrent nerve, usually, and diphtheria occasionally, cause paralysis on one side only. Affections of the nucleus of origin of the nerve are usually bilateral; and the other common cause of bilateral paralysis is the implication of both recurrents in growths in the upper part of the thorax. Diphtheria also sometimes causes paralysis of both nerves.

Symptoms.—In complete *unilateral* paralysis the affected vocal cord is usually in half-abduction, in the position assumed after death. Although there is loss of all movement, that of adduction is the obtrusive defect. In phonation the unaffected cord moves up to or beyond the middle line, while the paralysed cord remains motionless; and the movements outwards in inspiration and inwards in expiration, are performed only by the healthy cord. The voice, under these circumstances, may be hoarse, or it may be little altered, the healthy cord being moved beyond the middle line into sufficient proximity to the other to permit phonation. Complete approximation, such as is necessary for a cough, is impossible; and in the attempt to cough the patient only succeeds in driving air quickly through the open glottis, and no sudden explosive cough is possible. Sometimes, in complete unilateral paralysis, the affected cord is not in semi-abduction, but is nearly up to the middle line. It is in the position for phonation, and so there is no defective approximation in uttering vowel-sounds; but when phonation is over, and especially during inspiration, the healthy cord is abducted, while the paralysed cord remains motionless. Thus the loss of abduction is the conspicuous defect. On what the difference in the position of the paralysed cord depends, whether it is in abduction or in adduction, is not quite certain. The position of adduction is seen especially in paralysis of the recurrent nerve. A plausible explanation, which has been suggested to the writer by Dr. Poore, is that the position of abduction is the early state, and that after a time, in some cases, the unopposed crico-thyroid over-extends the cord, and so brings it into the middle line, just as in other organs, muscles, the opponents of which are paralysed, gradually, by their tonic shortening, alter the position of parts to which they are attached. In paralysis from disease of the roots of the spinal accessory at the medulla, the affected cord is always, as far as the writer has seen, in a state of partial abduction, a fact which harmonises with Dr. Poore's explanation, since, in this case, the crico-thyroid will also be paralysed. When the cord is in the position of adduction, the voice is high-pitched. At rest there is no dyspnœa, but on exertion the unabducted cord interferes with the entrance of sufficient air, and respiration becomes stridulous and short; but there is rarely, if ever, sufficient dyspnœa to render tracheotomy necessary.

*Bilateral* paralysis is much less common. It may be due to central disease; to diphtheria; to pressure on both recurrent laryngeal nerves from tumours in the upper part of the thorax; or to the injury of these nerves in the excision of enlarged thyroid. Two remarkable cases have been recorded (Baümler, Johnson), in which pressure on one recurrent laryngeal and vagus has caused paralysis of both vocal cords, in one case equally, in the other less on the side opposite to the tumour than on the same side. Dr. Johnson sug-

gests that the mechanism is probably an inhibition of the central nucleus on both sides, by the pressure of the afferent fibres in the vagus. In bilateral paralysis the same difference in the position of the cords is met with as in unilateral paralysis. Sometimes they are apart, in half-abduction, and sometimes approximated in adduction. In each case they are motionless. In the first instance the absence of the adduction for phonation is more conspicuous than the want of respiratory movement, and leads to the condition being designated *paralysis of the adductors*; in the latter the absence of the normal abduction on inspiration attracts chief attention, and there is said to be *paralysis of the abductors*. It is probable that Dr. Poore's explanation applies to these cases also. The difference between the two in their symptoms is very great. When the vocal cords are in abduction phonation is almost, or quite, impossible, and there is no closure of the glottis in cough. There may be no dyspnœa unless on very active exercise. When, however, the cords are near the middle line, the patient's condition is very different. He is able to speak, but only in a high, stridulous voice. The most urgent symptoms arise from the absence of the normal respiratory movements. Instead of being abducted in inspiration, the pressure of the air brings the cords closer together, while the current, in expiration, separates them. This inspiratory approximation of the cords constitutes a source of the gravest danger. When the patient is at rest enough air may enter to prevent dyspnœa, but exertion brings on stridor and intense difficulty of breathing. The least swelling of the cords occludes the glottis entirely. This condition is one of great rarity, and is most commonly due to central disease.

Slight impairment of adduction of the cords is a very common and much less grave affection, met with in general weakness, hysteria, and local inflammatory diseases. It has been termed 'phonic paralysis,' because in the slight effort of speaking the cords are not approximated, while in the stronger effort of the cough they are brought together perfectly. It does not result from nerve-lesions.

*Anæsthesia* of the larynx may result from disease of the superior laryngeal nerve, but is extremely rare from this cause. Lessened sensibility, bilateral, is not uncommon in central disease of the medulla.

(2) *Spasm.*—The common form of spasm of the laryngeal muscles is that of the adductors. The muscles which close the glottis are far more powerful than those which open it, hence any irritation of the nerves—direct, central, or reflex—causes closure. For this closure, since it plays an important part in many physiological processes, a central mechanism is provided, which is readily excited by various means. In cough, for instance, it may be excited, not only from the special afferent nerves of the throat, larynx, and lungs, but also by those of the stomach, and even, it is believed, by the branch of the vagus which goes to the external auditory meatus. Spasmodic cough may result from the simple irritability of the centre, as in hysteria; and a peculiar barking cough is occasionally the result of masturbation in boys. In whooping cough, again, the glottis, after being closed, is imperfectly relaxed, so that a sound accompanies the next inspiration. Simple laryngeal spasm, without implication of the expiratory muscles (laryngismus stridulus), occurs in children, in whom. in consequence of the constitutional condition known as rickets, the central nervous system is in a state of undue irritability. In this the vaso-motor centre seems to participate; a child, on some exciting cause, as a start, a reflex impression, or on none, suddenly turns pale, is unable to get its breath for a few seconds, and then, the spasm relaxing, air is drawn through the slowly opening glottis with a crowing noise. Quite similar attacks may occur in adults. It may be accompanied by distinct convulsive action elsewhere. In the paroxysms of epilepsy a similar combination is seen; the epileptic cry is the result of laryngeal spasm. Hydrophobia also is attended with a paroxysmal closure of the glottis.

Since the closure of the glottis is the physiological effect of irritation of the afferent laryngeal nerves, it is not surprising that spasm accompanies a large number of laryngeal diseases, varying in its prominence according to the irritative nature of the disease, and the irritability of the reflex mechanism; and, since the latter is most intense in children, we have in them a condition in which the slightest local catarrh gives rise to spasm. The attacks tend to occur especially at night, when the reflex centres, released by sleep from the control of the higher, are in their most active state. Spasm may occur, not merely from irritation of the laryngeal nerve, but from that of the vagus below (or by compression by tumour), the afferent nerves from the lungs being sufficient to generate it. Reflex spasm is always bilateral in character. Direct spasm by irritation of the recurrent laryngeal usually involves only one vocal cord; but in a few cases spasm so excited has been bilateral. This result can only be explained either by assuming the irritation of some afferent fibres, or by ascribing it to the spasm of the arytænoideus, which is a bilateral muscle (Krishaber).

A very rare condition of 'functional spasm' has been described, in which spasm is excited by attempts to speak. It has been thought to be similar in its nature to writer's cramp.

3. **Pulmonary Branches.**—The effect of disturbance of the pneumogastric on the respiratory movements, and the reflex effect of disturbances of the afferent pulmonary branches, have been already described. The muscular fibres of the bronchi are innervated by the nerve, and their paroxysmal contraction in asthma is thought to be produced through its agency. It has been asserted that the plain muscular fibres, said to exist throughout the lung-tissue, are supplied by it (Gerlach), and their contraction has been assumed to explain a peculiar form of emphysema, which has been observed in compression of the pneumogastric (Tuczek); but, since deep breathing of a costo-superior type was observed, it is possible that the effect is the result of the energetic respiration from the disturbance of the centre. The pneumogastric is commonly believed to contain vaso-motor fibres for the vessels of the lungs, but Brown-Séquard and Franck have separately shown that these fibres

are contained, not in the vagus, but in the sympathetic. Vascular lesions of the lungs have, however, been observed after section of the vagus. Michaelson noted rapid congestion and hæmorrhage. It is possible that this may be of reflex origin. The congestion noted after lesion of the pons may also be produced through the agency of the sympathetic. In a case of hæmorrhage into the pons, fatal in two hours, the writer found intense congestion with extravasation into the left lung, and hæmorrhages in the left extremity of the stomach.

After section of the vagus, animals die from chronic pneumonia, and hence the vagus has been supposed to be a trophic nerve for the lungs. But the changes have been accounted for by the entrance into the bronchi of food from the pharynx, in consequence of the obstructive paralysis of the œsophagus, and the paralysis of the larynx (Traube, Steiner). All admit that this is one cause of the pulmonary affection, but differ as to its adequacy in all cases. The question is still undecided.

4. **Cardiac Branches.**—The inhibitory effect of irritation, and acceleration of the heart's action, which results from lessened action of the vagus, have been before alluded to. The increased frequency has been several times observed in cases of local disease of the vagus in the thorax, compression by mediastinal tumours, &c. In a case of phthisis, for instance, in which the pulse was at first occasionally, and afterwards constantly, frequent (130–148), Meixner found the left vagus enclosed in a mass of enlarged glands in the upper opening of the thorax. The vagus is also the afferent nerve from the heart, and although we are normally unconscious of the cardiac action, some of the disordered sensations of disease are apparently produced through its agency. The subject of angina pectoris, and its relation to the vagus, are discussed in a separate article, but it may be here noted that in some anginal attacks the heart's action is, for a time, arrested or retarded, and that in a few cases these symptoms have been found associated with organic disease of the cardiac plexus. Thus in a case in which, during paroxysms of intense anginal anguish, the heart's action was arrested for four or six pulsations, Heine found a tumour involving the cardiac plexus. In a case recorded by Blandin, anginal attacks were associated with a small tumour of the vagus. Further, there are afferent fibres from the heart inhibiting the action of the vaso-motor centre, and these are probably stimulated in some anginal seizures.

After disease or injury of the vagus, the heart has been found in a state of fatty degeneration, and hence it has been thought that the vagus contains trophic fibres for the cardiac substance.

5. **Branches to the Alimentary Canal.**—The branches to the œsophagus are rarely diseased except in cases of affection of the nerve-trunk or of the centre. In very rare cases such disease has caused difficulty in swallowing, simulating stricture. Spasm of the œsophagus is more frequent. The vagus is the sensory, and in part the motor nerve for the stomach. Its fibres are very sensitive to any local irritation, and not rarely the seat of spontaneous neuralgia. Hunger is generally believed to be a pneumogastric sensation, and complete loss of the sensations of hunger and thirst were noted in a case of softening of the root of the vagus from an aneurism of the vertebral artery (Johnson). Appetite, however, is not always lost in animals when the pneumogastrics have been divided (Reid). In some cases of disease of the nerve, excessive appetite has been noted. This symptom, for instance, was noted in one case, in conjunction with dyspnœa, noisy breathing, and vomiting of unaltered food: *post mortem*, both pneumogastrics were found atrophied (Swan). In another case of insatiable appetite, small neuromata were found on the nerve. It is possible that the polyphagia may be in part the result of the defective digestion of food.

The pneumogastric is also in part the motor nerve of the stomach; after its section the contractions of the organ are lessened, although not altogether arrested. Vomiting is probably produced through its agency, by varied reflex and central irritation. In the latter case (as in meningitis) the vomiting is sometimes extremely rapid. The writer has known paroxysmal vomiting to result from the intermitting pressure of a tumour on the vagus; and Boinet, having exposed the vagus in an operation in the neck, noted that whenever he touched the nerve the patient vomited.

The vagus accelerates the contraction of the intestines, but no intestinal symptoms have been noted from its disease.

General Diagnosis.—The chief symptoms on which the diagnosis of disease of the vagus, in any given case, would rest, are the laryngeal paralysis; retarded respiration; accelerated or retarded heart; and vomiting. The diagnosis of the seat of the disease rests upon the range of the symptoms, and associated morbid processes. Disease of the trunk of the vagus is much less common than disease of its branches or roots. Paralysis of one vocal cord, for instance, is almost always the result of pressure, either on the recurrent laryngeal, or on the roots of the spinal accessory at the medulla. Bilateral symptoms are usually due to central disease, or else (if slight) are of merely local origin. In most cases of pressure on the trunk and branches of the vagus the cause of the symptoms is distinct, the only exception being deep-seated tumours in the thorax.

Prognosis.—The prognosis is that of the cause of the disease, and is sufficiently discussed in other articles.

Treatment.—Little can be said on the general treatment of the diseases of the pneumogastric, since it depends on the different conditions to which the symptoms are due, and which are described elsewhere. Central disease, and causes of pressure on the nerve are, as a rule, beyond the range of treatment. Whenever there is reason to suspect pressure on the nerve-roots (from the combination of paralysis of the tongue, palate, and one vocal cord), iodide of potassium should be given, since this is more frequently due to syphilis than to any other cause. In laryngeal paralysis the local application of electricity is sometimes useful, but more so in the weakness which depends on local causes than in that which is due to nerve-lesions. Injections

or strychnine are also sometimes useful, even, it is said, when its administration by the mouth is without effect. In central paralysis the treatment will depend on the indication given by the mode of onset regarding the nature of the lesion, whether softening or degeneration. In all spasmodic affections, sedative inhalations, especially chloroform, are useful; and bromides will lessen the irritability of the nerve-centre.

W. R. Gowers.

**PNEUMOGRAPH** (*πνεύμων*, the lungs, and *γράφω*, I write).—An instrument for recording the movements of respiration. *See* Physical Examination.

**PNEUMONIA** (*πνεύμων*, the lungs).—Inflammation of the substance of the lungs. *See* Lungs, Inflammation of.

**PNEUMO-PERICARDIUM** (*πνεῦμα*, air, and *περικάρδιον*, the pericardium).—A collection of gas in the pericardium. *See* Pericardium, Diseases of.

**PNEUMOTHORAX** (*πνεῦμα*, air, and *θώραξ*, the chest).—A collection of gas in the cavity of the pleura. *See* Pleura, Diseases of.

**POCK.**—A popular term for pustule, as though a pocket or pouch in the skin filled with pus. From the plural of pock is derived *pox*; hence, *small-pox*, *chicken-pox*, the *great pox* or *venereal pox*, and so forth.

**PODAGRA** (*πούς*, the foot, and *ἄγρα*, a seizure).—A common synonym for gout, as it usually attacks the foot. *See* Gout.

**PODALGIA** (*πούς*, the foot, and *ἄλγος*, pain).—A name for pain in the foot, due to any cause, such as gout, rheumatism, &c.

**POINTS DOULOUREUX** (Fr.)—Tender points in connection with the affected nerves in neuralgia. *See* Neuralgia.

**POISONOUS ANIMALS.** *See* Venomous Animals.

**POISONOUS FOOD.**—Under certain conditions, various articles of diet, especially meat, eggs, milk, butter, cheese, and honey, may become possessed of poisonous properties, and this may arise from a variety of causes, besides the introduction of known and specific poisons. Moreover, certain kinds of animal food—fish chiefly—may be possessed of definite toxic properties.

Food may be more or less poisonous—(1) from *unsoundness*, either from putridity or decomposition, and from disease; (2) from the presence of *parasites*; (3) from *mouldiness*, or presence of deleterious fungi; and (4) where the *flesh* is that of animals which have *fed on noxious or poisonous plants*; and under this head may also be classed poisonous honey, which bees have gathered from poisonous plants. (5) It may be of the nature of *poisonous fish*, using the term fish in the popular sense. Parasitic diseases might strictly be said to come under head (1); but as they are discussed in separate articles, the preventive measures to be adopted in the use of food infested with parasites will alone be treated of in this place. *See* Cysticerci; Tænia; and Trichina.

**Poisonous Vegetables.**—Unsound or even rotten vegetables and fruits may be consumed, especially in hot summers, and become fertile sources of varied forms of poisoning. The symptoms produced by the ingestion of large quantities of unsound fruit and vegetables are usually of a diarrhœal character, not often of an alarming severity, except in the cases of the young and feeble. They may, however, sometimes attain a fatal severity. The cause is usually obvious, and the treatment is simple—mild purgatives, as rhubarb or castor oil, with or followed by opiates, to remove peccant matters from the intestines; and stimulants, as ammonia or alcohol, if there be much collapse.

**Poisonous Meat.**—*Tainted or putrid Meat.* The obvious characteristics of good, sound flesh meat are that its colour is red—neither pale pink nor deep purple; that it is marbled in appearance; firm and elastic to the touch, scarcely moistening the fingers; having a slight and not unpleasant odour; and that when exposed to the air for a day or two, it should neither become dry on the surface, nor wet and sodden. Sound meat is *acid* to litmus paper; unsound meat may be neutral or alkaline. Meat may be tainted with physic administered to the animal. It is a common practice when a fat and valuable animal is unwell, to physic it, and if its recovery be not speedy to slaughter it. The meat of such animals may often be met with in our markets, and may induce illness from the physic with which it is contaminated. The effects of simple putridity are most varied. It is well known that some nations habitually eat, and even prefer, putrid in preference to fresh meat; and the development of rottenness in eggs for the epicure is an art in China. There is no doubt that habit has much to do with the tolerance of putrid meat—whether cooked or only partially cooked—by the stomach. But tainted game, and indeed all kinds of meat in which putrefaction has commenced, may, when taken, indubitably produce disease. This is chiefly of a diarrhœal character, preceded by rigors, and attended with collapse, and it may be convulsions and other signs of a profound affection of the nervous system.

The effects of such tainted meat are slight as compared with those which are produced by the sausage-poison, developed by a sort of modified putrefaction in certain German sausages. These sausages, when they become musty and soft in their interior, nauseous in odour and flavour, and acid to test-paper, acquire a highly poisonous character, and are frequently fatal in their effects. The symptoms produced by their use are gastric pain, vomiting, diarrhœa, depression, coldness of the limbs, and weak, irregular cardiac action. Fatal cases end in convulsions and oppressed respiration, death ensuing from the third to the eighth day. The nature of the sausage-poison, which is probably akin to that of putrid, and indeed all non-specifically tainted meats, has been a matter of considerable controversy. Some have held that the toxic action is due to the development of rancid fatty acids; others believe that a so-called catalytic body is produced, capable of setting up by contact a similar catalytic action. Others have regarded the sausage-poison as due to the formation of pyrogenous acids during the process of drying or smoking the sausages. The

recent discovery by Selmi of a class of poisonous alkaloids, termed *ptomaines*, developed during putrefaction of animal matters, on the one hand; and the discovery by Ballard and Klein, still more recently, that the fatally poisonous properties of ham prepared according to the American method, may be due to the presence of a parasitic bacillus, point to one or other of these two latter causes as the source of the effects of sausage-poison. Others have referred the effects to the presence of a microscopic fungus—*sarcina botulina*.

*Poisoned Meat.*—The poisonous nature of the flesh of animals which have fed on certain plants, for example, hares which have fed on certain species of rhododendron, pheasants on the calmia, &c., has been abundantly demonstrated, and need only be referred to here. The honey from bees which have garnered on poisonous plants, as the azalea, may likewise be deleterious; and the fact is of classical interest. The milk even of goats and other mammalia which have browsed on poisonous herbs has also proved poisonous.

*Diseased Meat.*—The poisonous effects of meat affected with certain parasites—trichina, cysticerci, trematodes, &c., are referred to in the articles bearing these names. Great quantities of meat pass through our markets which is undoubtedly the flesh of animals affected with disease—foot-and-mouth disease, pleuro-pneumonia, pig typhoid, the so-called scarlatina of swine, sheep-pox, &c.; and it is a quite undecided point as to whether such flesh produces any injurious effects. To stop the sale of such meat would undoubtedly be to cut off large sources of our meat supplies. The evils attending the use of such diseased meat, when well cooked, have undoubtedly been exaggerated; but, on the other hand, there is enough evidence to show that the use of certain kinds of diseased meat is followed by serious results. Thus it is generally admitted that the flesh of animals which have suffered from pleuro-pneumonia and murrain, will give rise to boils and carbuncles. Braxy mutton may also produce disease when eaten. Trichina will produce trichinosis; hydatids the tape-worm; &c.

**Poisonous Fish, Crustacea, and Mollusks.**—Cases of poisoning by fish, crustacea, and the so-called shell-fish of our islands are not unfrequently met with. Generally it is the ingestion of crabs, lobsters, and mussels which produces such results. These are usually of a distressing, rather than of a serious character, nettle-rash being a common symptom. Occasionally, however, fatal results have ensued from the use of mussels. In tropical seas poisonous fish are more plentiful—the golden sardine, the bladder-fish, the grey snapper, &c.; and these being eaten by larger fish, as the baracosta, perch, globe-fish, conger-eels, &c., the latter may become in turn poisonous.

Preventive and Curative Measures.—Good cookery, that is, exposure to a sufficiently high temperature for a sufficiently lengthened time, is undoubtedly the best treatment, short of absolute destruction, of unsound and diseased meat. So long as meat is high-priced, and the effects of diseased meat so little understood and so undefined, it will be impossible to induce medical officers of health and sanitary inspectors to seize all the diseased and unsound meat which is daily offered for sale. Notwithstanding all that has been said to the contrary, experienced observers are agreed that thorough exposure of the meat throughout to the temperature (140° Fah.) at which albumen is coagulated, is destructive to the parasites of flesh. Smoking is less effective. Salting is more effective than smoking; but there is some evidence to show that salting may merely hold the life of organisms in suspense without entirely destroying their vitality; and thus in the conversion of American salted pork into American hams in this country—a process of re-salting and subsequent drying—the specific germ (a bacillus) has been known to be again rendered harmful. It is not known whether efficient cooking entirely removes the deleterious effects of flesh affected with other than parasitic disease, as, for example, pleuro-pneumonia.

The curative measures for the results of eating poisonous food cannot be specifically described. They are those which must be arrived at on general principles. Symptoms are to be treated, and the powers of the patient sustained, until the deleterious matter is removed by excretion, or the trichina, *e.g.*, has become encysted.

Thomas Stevenson.

**POISONOUS GASES.** *See* Carbonic Acid; Carbonic Oxide; Prussic Acid; &c.

**POISONS.**—Synon.: Fr. *Poisons*; Ger. *Gifte*.

Definition.—There is no legal definition of the word *poison*, and the definitions usually proposed are apt to include either too much or too little. Generally, a poison may be defined as a substance having an inherent deleterious property, which renders it capable of destroying life by whatever avenue it is taken into the system. Substances which act only mechanically, such as powdered glass, are not poisons. In popular language, a poison is a substance capable of destroying life when taken in small quantities. A poison, then, may be defined as any substance which when introduced into the system, or applied externally, injures health or destroys life irrespective of mechanical means or direct thermal changes. *See* Poisonous Food.

Action.—Poisons may exert a twofold action. Their action is either local or remote, or both local and remote. The local action of a poison is usually one of corrosion, inflammation, or an effect on the nerves of sensation or of motion. The remote actions of a poison are usually of a specific character, though some writers group the remote effects of poisons under two heads, and speak of the common and specific remote effects of a poison. The local actions of a poison of the corrosive class are usually so well marked and so easily recognised, that the fact of its administration is obvious. The same may be said, in a lesser degree, of the irritant poisons, especially the mineral irritants; but here the symptoms often so closely simulate those of natural disease as to render the diagnosis a matter of great difficulty. An accurate acquaintance with the remote specific effects of the various common poisons is indispensable to the medical practitioner. The class of poison which has been administered or taken will thus be suggested to his mind by the symptoms observed, and not unfrequently the specific poison will be suspected.

In this way the physician may often be at once able to diagnose, from the symptoms alone, the administration of strychnia, henbane, or cantharides. Great care must be taken, however, not to draw a rash conclusion from the one symptom alone; as, for instance, from the tetanic spasms which are so marked a feature in strychnia-poisoning.

It is generally, but not universally, held that absorption is necessary in order that a poison should be able to exert its specific effect. Some, nevertheless, are of opinion that a poison may destroy life by an action on the nervous system before absorption has had time to take place. The facts in support of this view are, however, few, and open to doubt.

Modifying Circumstances.—The usual action of poisons may be greatly modified—(1) by the largeness of the dose, and the state of aggregation, admixture, or chemical combination of the poisons themselves; (2), by the part or membrane to which they are applied; and (3), by the condition of the patient. Thus, for example, opium may be a medicament or a poison, according to the dose in which it is given; and a dose of opium which may be beneficial to an adult in certain states of the system may be fatal to a young child, or to the adult when suffering, for example, from Bright's disease. All barium salts are poisonous, except the sulphate, which is one of the most insoluble of all mineral substances. The simple cyanides are highly poisonous, and the same may be said of many double cyanides. But the double cyanide of iron and potassium (potassium ferrocyanide) is almost without action on the system. The part or tissue to which a poison is applied must obviously greatly affect the activity of a poison, owing to the varying rapidity with which absorption takes place through the cutaneous, mucous, serous, and other surfaces of the body. Curare may be swallowed in a considerable dose, without producing any appreciable effect, whilst a small quantity of the same substance introduced into a wound will speedily prove fatal. It has been found that when a poison is slowly absorbed, so that it can be either disposed of in the system or again excreted more rapidly than it is absorbed, no poisonous results ensue; but when absorption occurs so quickly that the poison can neither be excreted nor destroyed in the system as rapidly as it is absorbed, the specific effects of the poison are developed. Curare, for instance, is absorbed by the gastric mucous membrane more slowly than it is excreted through the kidneys. But if the renal arteries be ligatured, the poison accumulates in the blood, and the specific effects of the poison are developed, just as when curare is introduced into a wound.

*Idiosyncrasy* has much to do with the poisonous or hurtful character of a substance. Thus pork, mutton, certain kinds of fish (notably shellfish), and fungi (*see* Mushrooms, Poisoning by), have, under certain circumstances, and in certain persons, produced all the symptoms of violent irritant poisoning; whilst others, who have partaken of the same food at the same time, have enjoyed perfect immunity. More commonly all who partake are affected, but with varying degrees of severity. Some persons are said, on good authority, to be capable of taking with impunity such violent poisons as corrosive sublimate or opium, in enormous doses, and this independently of habit, which is known to have such a large influence in modifying the effects of some poisons, notably of the narcotics. A tolerance of poisons is sometimes engendered by disease, so that a poison may from this cause fail to produce its accustomed effect. Thus opium is largely tolerated in tetanus, and in mania from drink; and mercurial compounds may in severe febrile affections fail to produce the usual constitutional effects of the metal. On the other hand, kidney-disease, by impeding elimination, may intensify the ordinary effects of a poison, and the like is observed when opiates are given where there is a tendency to cerebral congestion.

Evidence.—In order to raise a valid inference in the mind of the medical attendant that poison has been administered to a patient, certain facts must be brought under his notice; and without the concurrence of at least two or more of these, the actuality of poisoning cannot be maintained. The sources of evidence in cases of suspected poisoning are the *symptoms*, the *post-mortem appearances*; *chemical analysis* of articles of food or drink, or of the body and the excretions; and *experiments upon animals*. The evidence derived from these sources being compared with the known properties and effects of various poisons in authenticated cases, will enable the physician to form a correct opinion as to the probable administration or not of a poison. The poisons most commonly administered are opium, prussic acid, arsenic in various forms, phosphorus, oil of vitriol, and oxalic acid.

It is rarely that the *symptoms* exhibited during life do not afford some clue to the cause of illness; and most frequently the symptoms are all that the medical attendant has to guide him to a diagnosis of the nature of the case, during the lifetime of the patient. Sometimes, however, persons are found dead as the result of poison, concerning the manner of whose death nothing whatever can be learned; a suspicion of poisoning arising from the circumstances under which the corpse is found. Here the aid of chemical analysis ought invariably to be invoked; and fortunately in these cases the delay involved in making an analysis is of comparatively little moment. The effects may in the case of many persons be either suddenly or slowly manifested; hence we have *acute* and *chronic* poisoning. Cases of chronic poisoning are usually the result of the repeated administration of small doses of lead, copper, mercury, phosphorus, or arsenic. All of these poisons are treated of in separate articles. The general conditions which should excite a suspicion of poisoning are the sudden onset of serious and increasingly alarming symptoms, in a person previously in good health, especially if a prominent symptom be epigastric pain; or where there is complete prostration of the vital powers, a cadaverous expression of the countenance, an abundant perspiration, and speedy death. In all such cases the aid of the chemist is required, either to confirm well-founded, or to rebut ill-founded, suspicions.

Classification.—Various attempts have been made to classify poisons rationally. Perhaps the best classification, for the purposes of the medical practitioner, is that which groups poisons according to the more obvious symptoms which they produce. Our knowledge of the more intimate action of many poisons is still too slight to admit of any useful classification according to the manner in which they specifically affect the vital organs.

Poisons may in the manner indicated be classified as:—1. **Corrosives**; 2. **Irritants**; and 3. **Neurotics**. It is perhaps at present premature to attempt a systematic division of the last class. The class of neurotics embraces poisons so widely different in their action as opium and strychnine.

1. **Corrosive Poisons.**—Enumeration.—The action of one of the most typical of these poisons, corrosive sublimate, is fully considered under a special head (*see* Mercury, Poisoning by). The most commonly administered corrosives are the mineral acids—sulphuric, nitric, hydrochloric, and oxalic acid; the alkalies—potash, soda, and ammonia; acid, alkaline, and corrosive salts—such as potassium bisulphate, potassium carbonate, zinc, tin, and antimony chlorides, and silver nitrate.

Symptoms.—The mineral acids and the alkalies have scarcely any remote effects on the system, their action being almost purely local. Some of the other corrosives enumerated may have, besides their local effects, a remote and constitutional action. The symptoms of corrosive poisoning are marked and unmistakable, except when the patient is an infant. Immediately after swallowing the corrosive substance, there is an acid, caustic, or metallic, burning sensation felt in the mouth, fauces, gullet, and stomach; and this speedily extends over the whole abdominal region. Vomiting is speedy, or may, rarely, be altogether absent. The vomited matters consist at first of the ordinary contents of the stomach, more or less altered by the action of the poison. In the case of *mineral acids* they are intensely acid, and cause copious effervescence when they fall upon limestone or marble. No relief is afforded by the evacuation of the stomach; and later the vomits may be more or less mingled with altered blood, which may be dark, or even black; shreddy mucus, casts of the gullet or stomach formed by the shedding of the mucous membrane, and sometimes even the muscular wall of the œsophagus, are rejected. The abdominal pain is not relieved, but greatly aggravated, by pressure. The whole abdomen becomes distended, owing to the gases evolved by the action of the poison; the diaphragm is pressed upon; and intense dyspnœa may result, owing to pressure upon the thoracic viscera. When a mineral acid has been administered, there is little or no bowel action, and the urine may be suppressed; but in poisoning by the *alkalies*, and by the *alkaline carbonates* and *sulphides*, there may be purging. The mouth, tongue, and fauces exhibit the local effects of the corrosive; a yellow coating in the case of nitric acid; white at first, and as if covered with white paint, from sulphuric acid; and whitish or brown and less thickly coated from hydrochloric acid. Yellow or brown stains may be observed on the skin, extending downwards from the angles of the mouth, and caused by the trickling of acid or other corrosive fluid from the mouth. Meantime the symptoms develop rapidly. The pain, thirst, dyspnœa, and dysphagia increase. The patient, at first excited, with rapid, bounding pulse, becomes bathed in cold perspiration, the countenance becomes pinched, the pulse more rapid and thready. Enormous eructations of gas take place, but these afford no relief. The patient may become more or less cyanosed; but this will depend upon the amount of dyspnœa. The intellect is usually clear to the last. Signs of collapse come on, and the patient may sink within a period varying from six to twenty-four hours. If recovery does not take place, death usually supervenes within a period of twelve to twenty-four hours. Very frequently, and more especially in poisoning by oil of vitriol, the patient survives the first acute symptoms only to perish months after, should not the aid of the surgeon be invoked and gastrotomy be performed, by slow starvation, due to local injury to, and subsequent stricture of, the œsophagus. The use of bougies in these cases, to keep the gullet patent, seldom affords permanent relief.

When *nitric acid*, or *ammonia*, is the poison taken, the vapours of the acid or of the ammonia may gain access to the air-passages and lungs, provoking inflammation, which is commonly fatal. The dyspnœa and chest-symptoms will be greatly aggravated in these cases, and may overshadow the more usual symptoms due to local action on the digestive canal. In poisoning by the *caustic alkalies* (potash and soda lyes) diarrhœa, with discharge of blood, is more common than the constipation observed in poisoning by the mineral acids. Entire suppression of urine, or anuria, is the rule in poisoning by corrosive sublimate.

*Oxalic acid* in concentrated solution is undoubtedly a corrosive and irritant poison. Very commonly, however, it kills by its depressing action upon the heart before symptoms of corrosion have become prominent; or the vomiting, pain, and other more immediate symptoms of corrosive poison, are associated with a feeble pulse, clammy skin, nervous symptoms, aphonia, and speedy death, even within ten minutes of the administration of the poison. To quote Christison's language:—'If a person, immediately after swallowing a solution of a crystalline salt, which tasted purely and strongly acid, is attacked with burning in the throat, then with burning in the stomach, vomiting, particularly of bloody matter, imperceptible pulse, and excessive languor, and dies in half an hour, or still more in twenty, fifteen, or ten minutes, I do not know any fallacy which can interfere with the conclusion that oxalic acid was the cause of death. No parallel disease begins so abruptly and terminates so soon, and no other crystalline poison has the same effects.' It must be added that binoxalate of potash, and the soluble oxalates generally, are as poisonous as the acid itself.

Anatomical Characters.—The distinction between corrosive and irritant poisons is by no means well-marked; and indeed corrosive poisons, when diluted, act as irritants. Hence we shall

describe the *post-mortem* appearances of corrosive poisoning under the head of irritants.

Diagnosis.—The diagnosis of corrosive poisoning rarely admits of difficulty; and in any doubtful case analysis will remove all doubt.

**2. Irritant Poisons.**—Irritant poisons are of two classes—*metallic irritants*, and *vegetable* and *animal irritants*, these latter being grouped together. Perhaps none of them, however, act as pure irritants; and the irritant symptoms which they produce are most commonly accompanied by a well-marked effect upon the nervous system also. An irritant is a poison which causes inflammation of the parts to which it is applied, usually the alimentary canal. By far the most important of the metallic irritant poisons is arsenic (*see* Arsenic, Poisoning by). Other metallic irritants are the salts of antimony, zinc, and other metals. Elaterium, essential oils, and gamboge may be cited as examples of vegetable irritants; and cantharides of animal irritants. Irritant animal and vegetable foods are separately described. *See* Poisonous Food.

Symptoms.—Irritants differ as a rule from corrosive poisons in the greater slowness with which the symptoms are developed. Usually when an irritant is swallowed, after an interval—greater or less according to the specific character of the poison—a burning pain is felt, and sense of constriction of the mouth, throat, and gullet, speedily followed by sharp burning pain in the epigastrium; and this is increased by pressure—a mark which serves to distinguish the attack from one of ordinary colic. Nausea, vomiting, and great thirst ensue; speedily followed by pain and sense of distension of the whole abdomen, which is exceedingly tender, and perhaps visibly distended. Most commonly the vomiting is followed by purging, tenesmus, dysenteric stools, and often by dysuria. Should the poison not be speedily removed from the system by vomiting and purging, these continue unrelieved, and increase in severity; and symptoms of inflammatory fever, or it may be of collapse, supervene. The pulse becomes rapid, small, and thready; the countenance is anxious; the skin is bathed in perspiration, now warm, and again cold and clammy. The patient may never rally from the first shock to the nervous system; more rarely, having survived this, he dies in convulsions; or he may perish of inanition after more protracted sufferings. It must be borne in mind that those irritant poisons—such as diluted sulphuric acid—which, when taken in a more concentrated form, act as corrosives, may bring about starvation, necessitating such operative procedure as gastrotomy, by the injury which they inflict upon the œsophagus and stomach. Death after the administration of an irritant poison may, it is obvious, occur at very varying periods after the ingestion of the poison.

Diagnosis.—Irritant poisoning may be mistaken for various forms of natural disease. The diseases with which it is most apt to be confounded are—gastritis; gastric ulcer, with or without perforation; peritonitis; severe colic; sporadic and Asiatic cholera; and rupture of the stomach or intestines. A careful examination of the patient, and the history of the case, will often remove any doubt which may be entertained; but a microscopic examination and chemical analysis of the ejecta of the patient will frequently afford the only means of clearing up the case during life. Too frequently irritant poison is not suspected until a *post-mortem* examination is made. In every case where a possibility of irritant poisoning is suggested, the aid of analysis should be invoked. For the diagnostic differences—so far as differences in symptoms are diagnostic—between irritant poisoning and the special diseases above mentioned, the reader is referred to the special articles in this dictionary.

Anatomical Characters.—The *post-mortem* appearances in irritant and corrosive poisoning are corrosion of the mouth, fauces, gullet, and stomach, the mucous membrane being shrivelled, altered in consistence and colour, and more or less detached; irritation and inflammation of the stomach and first portion of the small intestines; ulceration; and erosion. In corrosive poisoning the stomach may be perforated, the edges of the aperture being shreddy; and in the case of sulphuric acid the viscera may be blackened (altered blood) from the action of the acid upon the blood-pigment. The small intestines are implicated to a varying extent, or may altogether escape. The large intestine may be attacked, and this is more especially the case in poisoning by mercurial preparations. Arsenic exerts a specific effect upon the gastric mucous membrane. Remains of irritants may be detected in the intestinal canal, and be recognised by their physical, microscopical, and chemical characters.

**3. Neurotic Poisons.** — Enumeration. — Under this head may be ranged a great number of poisons, having this in common, that the symptoms produced by them are more or less prominently affections of the nervous system. The class embraces pure narcotics, such as morphia; chloral hydrate; hyoscyamus; digitalis; strychnia; prussic acid; nitro-benzol; phenol (carbolic acid); alcohol; aconite; belladonna, and many others.

Symptoms.—These are necessarily of the most varied character. All that has been said already about the onset of symptoms, their character, and the circumstances under which they have appeared, must be borne in mind in arriving at a diagnosis.

*Prussic acid* produces its effects in the course of a few minutes; or, it may be, seconds. The course of symptoms is very rapid; and death may be well-nigh instantaneous. The symptoms are convulsions, great disturbance of respiration, with prolonged expiration, dilated pupils, and cyanosis. *See* Prussic Acid, Poisoning by.

*Morphia* and *opium*, after a stage of excitement, produce deep comatose sleep, with slow stertorous breathing; contracted pupils; and clammy, perspiring skin; all the other secretions being more or less suppressed. *See* Opium, Poisoning by.

*Aconite* is diagnosed by the peculiar numbness and tingling of the skin which it produces.

*Belladonna*, and its alkaloid atropine, widely dilate the pupils, and cause intense thirst, with mirthful delirium and spectral illusions.

*Alcohol* in toxic doses produces profound insensibility; and there is, moreover, always more

or less recognisable by circumstances which will be found described under ALCOHOLISM.

*Nitrobenzol* causes symptoms often undistinguishable from those of prussic acid; but in consequence of its insolubility, and the slowness with which the liquid poison is absorbed by the gastro-intestinal mucous membrane, there is often a prolonged interval between the administration of the poison and the onset of alarming symptoms.

*Chloral hydrate* causes death after a stage of unconsciousness; and there is scarcely any difficulty in ascertaining the nature of the case by the aid of the surroundings of the patient.

*Carbolic acid* or *phenol* whitens and shrivels the membranes with which it comes in contact, and not only acts as a corrosive, but produces speedy narcosis, and greenish or black urine. The peculiar odour of phenol is always perceptible, though not infrequently overlooked.

DIAGNOSIS.—It is impossible to enter fully into the diagnosis of each individual neurotic poison. The most frequent and important diagnoses have to be made in supposed cases of poisoning by opium, alcohol, and strychnia respectively.

In opium-poisoning the equally contracted pupils; the possibility of rousing the patient by means of external stimuli in all except the later stages—as, for instance, by flicking the feet, the application of the electric current, &c.; and the moist clammy skin, may serve to prevent the case being confounded with one of apoplexy. In alcoholic coma there is great danger of mistaking the nature of the case, in consequence of the frequency with which the alcoholic odour may be met with in cases where alcohol has been taken, either dietetically or medicinally, in moderate or somewhat immoderate doses. The very careful use of the stomach-pump can do no harm, and may not only save the patient if the case be one of alcoholic poisoning, but also serve to clear up the diagnosis. The tetanic spasms of strychnia will have to be differentiated from those of true (traumatic) tetanus. In this there is not usually any insuperable difficulty. Strychnia convulsions are intermittent; do not begin in the lower jaw; are, as a rule, opisthotonic in character; and do not affect the same groups of muscles as are implicated in true tetanus. *See* OPIUM, Poisoning by; and STRYCHNIA, Poisoning by.

TREATMENT.—Only the general principles of the treatment of poisoning can be indicated here. The treatment in poisoning by the most important special poisons is described in separate articles. The question of the use or non-use of the stomach-pump must be decided by the nature of the poison administered. Where one of the concentrated mineral acids, a caustic alkali, or other corrosive salt, oxalic acid in concentrated solution, or carbolic acid, has been swallowed, it is generally held that the stomach-pump should not be used, the danger of perforation of the gullet or stomach being considerable. In all cases where a non-corrosive poison has been taken, except in the case of prussic acid, where the course of the poisoning is too rapid to permit of the use of the instrument, the application of the pump is advisable and can do no harm. In cases of poisoning by opium and alcohol, the greatest reliance must be placed on evacuation of the stomach by its aid. The corroding acids may be neutralised by the administration of lime-water, or, still better, saccharated lime-water; highly diluted solutions of the caustic alkalies; or, failing these, the continuous use, in frequently repeated doses, of chalk, whiting, or the alkaline carbonates—so as to avoid dangerous distension of the abdomen with carbonic acid gas. On the contrary, the caustic alkalies may be neutralised by the copious imbibition of highly diluted acid liquids. Failing the use of the stomach-pump, or even after the use of this, emetics may be administered to relieve the stomach of irritants. The prompt administration of an emetic is perhaps never inadmissible. The effects of corrosives and irritants must afterwards be met by general remedies, such as demulcents and oil to sheathe the mucous membranes, opiates to relieve pain, &c. The effects of oxalic acid cannot be avoided by the administration of alkalies and alkaline carbonates, for the alkaline oxalates are themselves highly poisonous. Chalk, whiting, and soluble lime-salts precipitate oxalic acid as an insoluble calcium oxalate, and form the best remedies. No safe antidote is known for carbolic acid. Oil greatly allays the intolerable pain attending the local action of this acid. In prussic acid poisoning artificial respiration, persistently used, is our sheet-anchor, and may be supplemented by galvanism, alternate douches of warm and cold water, and other measures. After the use of the stomach-pump to remove unabsorbed opiates, stimulating liquids containing tannin, such as strong black coffee, may be given; the patient must be kept awake by walking him about, flicking the feet with towels, the application of the Faradic current, &c. Belladonna in full doses is in some respects antagonistic in its physiological action to opium. Conversely opiates are regarded as direct antidotes to belladonna. On the same principle of counteracting effects, digitalis and aconite are counter-poisons, and hence antidotes the one to the other. The happiest results have followed the use of full doses of chloral-hydrate in strychnia-poisoning; and chloroform may be freely inhaled to allay the tetanic spasms. In alkaloidal poisoning, except where a tetanising poison, such as strychnia or brucia, has been given, the stomach-pump must be employed; and emetics and tannin, in the form of tincture of galls, strong black coffee, or strong tea, should also be given, with the object of precipitating the alkaloid as an insoluble tannate.

THOMAS STEVENSON.

**POLYDIPSIA** (*πολὺς*, much, and *δίψα*, thirst).—A synonym for excessive thirst; sometimes used for diabetes. *See* POLYURIA; and THIRST.

**POLYPHAGIA** (*πολὺς*, much, and *φάγω*, I eat).—A synonym for excessive hunger. *See* APPETITE; and PNEUMOGASTRIC NERVE, Diseases of.

**POLYPUS** (*πολὺς*, many, and *πούς*, a foot).

SYNON.: Fr. *Polype*; Ger. *Polyp*.

DEFINITION.—This term is generally applied to any simple pedunculated growth, springing from a mucous surface; but it is sometimes ex-

tended so as to include malignant pedunculated growths in similar situations.

Varieties.—It is clear that no single description will apply to each member of the class. Hence it will be sufficient to enumerate the principal varieties of polypus, a fuller account of most of which will be found in the article Tumours, and also in connection with the diseases of the several organs which they affect.

1. **Polypi of the Nose.**—These are of two varieties—the *mucous* and the *fibrous*; both are classed among the fibromata. Both are covered with ciliated epithelium; the fibrous variety often involve the structures at the back of the pharynx, forming the so-called *naso-pharyngeal polypus.*

2. **Polypi of the Ear.**—Polypi of the ear resemble those of the nose, but present a variety of structure, as some spring from the membrana tympani, others from the interior of the tympanum.

3. **Polypi of the Intestines.**—These polypi are of much more frequent occurrence in the rectum than in any other portion of the intestinal tract. They are composed of tissue resembling that of the mucous membrane of the part, and are described amongst the adenomata.

4. **Polypi of the Uterus.**—These growths are of three kinds, namely:—(*a*) *Cystic,* which are derived from the ovules of Naboth; (*b*) *mucous* or *soft,* resembling the polypi of the rectum; (*c*) *hard* or *fibrous,* the so-called fibrous polypus of the uterus.

5. **Polypi in other situations.**—Less common forms of polypi, consisting of some modification of the mucous membrane from which they are derived, are found in the *bladder,* the *larynx,* on the *gums,* or sometimes in the *sinuses communicating with the nose.*

*Malignant polypi* present no special features which would enable them to be described as a class.

Treatment.—Though polypi differ somewhat in structure, the treatment of the simple varieties of the class is the same—that is, if removal be considered advisable. Either the pedicle may be grasped and the tumour removed by avulsion; or it may be divided at a stroke by some sharp instrument, or cut through slowly or rapidly by some form of écraseur or ligature.

In removing a malignant polypus a wide margin of healthy tissue must be taken away from around the pedicle. R. J. Godlee.

**POLYSARCIA** (*πολύς,* much, and *σάρξ,* flesh).—A term for excessive corpulence or obesity. *See* Obesity.

**POLYURIA** (*πολύς,* much, and *οὖρον,* urine). Synon.: *Diabetes Insipidus*; Fr. *Polyurie*; *Diabète Insipide*; Ger. *Zuckerlose Harnruhr.*

Definition.—A malady or group of maladies, characterised by thirst, and a persistently excessive flow of watery urine, which has a low specific gravity, and contains no albumin or sugar.

Attempts have been made to subdivide this group into smaller sections. One such section is *polydipsia* or *hydruria,* having the characters above specified as those of polyuria; another is *azoturia,* where the solids, especially urea, are in excess of the normal amount; and a third, *anazoturia,* where these are markedly deficient. The term *polydipsia,* referring as it does specially to the symptom thirst, often used, puts the cart before the horse. *Hydruria* points to the dilute character of the urine rather than to its excessive quantity. *Azoturia* has been made to include all cases where urea is unusually abundant, even where the urine is scanty, as in fevers; a condition totally averse from our notions of diabetes. *Anazoturia* very rarely occurs; for, notwithstanding the low specific gravity of the urine in polyuria, owing to the large amount passed, the quantity of urea may, and often does, exceed that excreted in health. A form of polyuria, often slightly marked, has been described as 'phosphatic diabetes,' on account of the excess of phosphates passed. The separation of these cases into a distinct group is hardly necessary. Certain factors in the above definition require special attention, the better to mark off the malady so defined from other pathological states. Thus the flow must not only be excessive, but persistently so. This separates polyuria from conditions where there exists a merely temporary flow of an unusual amount.

Ætiology.—Polyuria is limited neither by age nor by sex. It may exist in the new-born infant, and it may be found in the patient of seventy, but on the whole it is a disease of early rather than advanced life, whilst it is about twice as frequent in males as in females. Nothing is more marked in connection with the causation of polyuria than heredity. Perhaps the most extraordinary example of this is recorded by Dr. Gee, where the disease was directly transmitted through four generations. Sometimes one member of the family escaped, but the children were sure to be attacked. A newly-born infant, a member of this family, suffered from unusual thirst, so much so that water had to be given to still it.

Beyond inheritance, nothing very definite can be said as to the cause and origin of polyuria. It is often connected with nervous affections or nervous excitement, and sometimes follows upon injuries to the head or disease of the brain. Drinking bouts too have been credited with giving rise to the disease, as have drinking cold fluids, and sudden exposure to cold. Beyond these, no cause of any value can be assigned; often indeed the disease comes on without even such insufficient reasons as those given above, some of which have doubtless been assigned on the *post hoc* principle.

Symptoms.—Not much need be said regarding the clinical history of polyuria. When the result of accident or mental emotion, its onset is usually abrupt, and it may end in like manner; sometimes as the result of intercurrent disease of a febrile kind. During its continuance thirst and watery urine are the two prime symptoms, for there may be little wasting, and the general health may be good. Occasionally there is increased appetite, as in one of Trousseau's patients, whom *restaurateurs* would pay to stop away. In this patient, too, there was great tolerance of intoxicating liquors, whilst in others the opposite condition has been noted. Usually the bowels are con-

fined, and the skin dry, though neither happens invariably. Boils, so common in diabetes, are rarely seen; but purpuric spots sometimes occur, as does œdema, or that laxness of subcutaneous tissue which often passes for œdema, in the later stages. As long as drink is supplied in plenty, the condition of the patient is very tolerable, were it not for the broken sleep caused by the incessant thirst and the desire to pass water; but any attempt to restrict the quantity of fluid gives rise to intense discomfort, even causing the patient to drink his own urine. Ultimately this constant strain wears out the patient, and leads to death, if intercurrent disease do not carry him off.

Of the phenomena of polyuria, the urine alone requires special notice. It is inordinate in its quantity, and of a specific gravity little above that of spring water. In a case under the care of the writer, it remained persistently at 1,001; but it may rise to as much as 1,008 or 1,010. It is transparent; almost like water; of a faint greenish-yellow tint; and with little taste, smell, or acid reaction. In quantity it varies with the amount of water consumed. If the patient is allowed to drink at will, the quantity passed roughly corresponds with that drunk, allowance being made for the watery vapour passing away by the lungs, and perhaps also by the skin. If the drink be restricted, more will be passed than is consumed, by the abstraction of water from the body. On the whole the quantity passed is greater than in ordinary diabetes, and may sometimes be measured by the pailful. Of the normal constituents of urine, urea, though relatively deficient in any specimen examined, is upon the whole in excess, sometimes enormously so. On the other hand, uric acid seems diminished, but this may depend on the difficulty of estimating it in urine so greatly diluted. Sulphates and phosphates, especially the earthy salts of the latter, are usually increased, whilst the only abnormal constituent, if such it can be called, commonly found is inosite.

Pathology.—As in the case of saccharine diabetes, our insight into the morbid processes concerned in the production of polyuria has been greatly aided by direct experiment. Bernard found that by pricking the floor of the fourth ventricle above the level of the 'sugar puncture' he could produce copious diuresis; and in certain animals injuries to the central lobe of the cerebellum (the vermiform process of human anatomy) are followed by a like result. From this part of the nervous system the nervous influence seems propagated to the kidneys both by the splanchnics and spinal cord, but the exact course of the fibres has not yet been clearly demonstrated. Whether the nerves are merely vaso-motor fibres, section or paralysis of which would produce turgescence of the vessels of the kidneys, or trophic fibres, irritation of which would increase the activity of these organs, is not yet determined; but in all probability paralysis of the vaso-motor fibres is the main factor in the production of hydruria.

In the definition of polyuria given above disease of the kidneys was expressly excluded; and after death, as far as the malady itself is concerned, nothing is to be found except increased vascularity. As a consequence of the disease, however, persisting over many years, and giving rise to frequent and severe distension of the bladder, when circumstances may prevent its being emptied with sufficient frequency, thickening of the walls of the bladder, dilatation of the ureters, and sacculation of the kidney have been described; but the accuracy of such observations as the results of simple polyuria have been questioned. Undoubtedly the most important lesions which bear on the disease are those which have been found in the brain, especially in the neighbourhood of the fourth ventricle. These, besides the injuries already alluded to, comprehend tubercular and other forms of inflammation, tumours of various kinds—gliomatous and syphilitic, together with other local changes of different kinds.

Diagnosis.—The diagnosis of polyuria, according to the definition already given, is easy. It rests on these factors—thirst, and persistent excess of urine, coupled with the absence of sugar and albumin. It has further to be carefully distinguished from mere temporary excess of watery urine. Such an excess may occur where a large quantity of fluid of a diuretic kind has been swallowed, especially when there is little or no cutaneous transpiration. Again sudden flows of urine may occur about the period of early convalescence from fever, or yet again when a hydronephrosis suddenly empties itself. All these are merely temporary and evanescent states. The total absence of sugar distinguishes polyuria from diabetes, though it is well known that the one state may pass into the other. In certain forms of Bright's disease, especially those characterised by contracted kidney, the urine may be excessive and of low specific gravity; but in all of these albumin will be at least now and again found. Finally, polyuria is not to be confounded with such abnormal discharges of urine as may occur from time to time in what we call hysteria and its allies. Here the nervous symptoms give a special feature to the malady; nevertheless polyuria has strongly marked nervous affinities.

Prognosis.—This cannot be called favourable, for, whilst few actually perish from the uncomplicated disease, still fewer are cured of it, though a good many get well. For some unaccountable reason, Trousseau looked upon polyuria as more dangerous than diabetes; but ordinary experience cannot bear out this view. Probably its connection with tubercular disease in many cases misled him. Under such circumstances the tubercular disease would run its course just as disease of the nerve-centres would, altogether independent of the polyuria.

Treatment.—As might be inferred from the account of the disease given above, the treatment of polyuria is far from satisfactory. If the disease can be assigned to any definite cause, we must look to that and deal with it, rather than with the excessive urination; if not, it must be our endeavour to counterbalance the draining of the tissues, and the corresponding waste, by a plentiful supply of fluid and good nourishing diet. To relieve the kidneys from the unusual stress thrown upon them, diaphoretics have been recommended; at all events great care should be taken of the clothing so as to secure the patient

from any risk from cold. Of medicinal remedies, that which has been most lauded is valerian, especially by Trousseau, who gave it in enormous doses. Probably it, like other antispasmodic remedies, would be found of most service in cases allied to hysteria or similar neuroses. In one case under his care, the writer tried the whole range of antispasmodic remedies without effect. Opium and its alkaloids, though so serviceable in diabetes, are worse than useless in polyuria. They diminish the thirst and the urine, but they greatly increase the patient's discomfort. Tonics, especially strychnine and iron, do good by improving the general health. In another case under the care of the writer, in a highly scrofulous subject, after every medicinal remedy had been tried in vain, change of air at the seaside was followed by almost complete disappearance of the polyuria. The importance of attending to the constitutional state is strikingly indicated in this case. Finally, in the hands of some the constant electric current has done good, whilst it has equally failed in the experience of others.

ALEXANDER SILVER.

**POMPHOLYX** (πομφὸς, a bulla or bladder). This term is applicable to the bullous affection of the skin more commonly denominated pemphigus, of which it is, in fact, a synonym. *See* PEMPHIGUS.

**PONS VAROLII, Lesions of.**—SYNON.: Fr. *Maladies de la Mésocéphale*; Ger. *Krankheiten der Brücke.*

INTRODUCTION.—The pons is liable to a variety of affections, either by morbid processes having their primary seat here, or by secondary implication from disease originating elsewhere, as by tumours of the cerebellum or base of the skull, or aneurism of the basilar artery.

The position of the pons, its close relation to the vital centres of the medulla oblongata, the connection of the sensory and motor paths with the cerebrum and spinal cord on the one hand, and the cerebellum on the other, and the transit through it of many of the cranial nerves, render the symptomatology of pontine affections highly complex and diversified.

SUMMARY OF PATHOLOGICAL CONDITIONS.—*Hæmorrhage* in the substance of the pons is by no means uncommon, and may vary from a minute focus up to a complete disorganisation and rupture into the fourth ventricle. *Embolism* is not common; but *thrombosis*, from *syphilitic* or *atheromatous degeneration* of the basilar artery, is frequent, and is the origin of necrotic *softening* of an acute or chronic character.

*Hæmorrhage.*—Hæmorrhage into the substance of the pons, if of small extent, is not necessarily fatal; but if it be of large amount, death occurs suddenly, or within a very few hours. Sometimes there is a sudden onset of coma, with complete relaxation of the whole muscular system. The pupils are, as a rule, minutely contracted, and the condition resembles profound narcotic poisoning. The temperature may rise to as much as 105° Fahr. or more. Deglutition is difficult or impossible; and death ensues from cardiac and respiratory paralysis, irregularity in the rhythm preceding the fatal issue. At other times, and of great signification in a diagnostic point of view, muscular spasms occur, either general or affecting one side more than the other, with distortion of the face, either from paralysis of one side, or this combined with active spasm of the other.

The occurrence of paralysis of one side of the face and of the limbs of the other side, so-called 'alternate' paralysis, is pathognomonic of the pontine seat of the lesion.

*Softening.*—Acute embolic or thrombotic softening of the pons, with or without loss of consciousness, may lead to death rapidly, with similar paralytic symptoms; but days may elapse, or even months, after the first onset, with characteristic symptoms indicative of the position of the lesion, and death ensue either from gradual implication of the vital centres, or quite sud denly.

LOCALISING PHENOMENA.—The symptoms most characteristic of lesions of the pons are a combination of paralysis of certain cranial nerves on the one side, and of the limbs on the other. The most common combination is paralysis on one side of the face and of the limbs on the opposite, the face being paralysed on the side of the lesion. The facial paralysis in this case resembles peripheral facial paralysis, both in the implication of the orbicularis oculi and degenerative changes in the muscles. The limbs may be paralysed as to motion only, or there may be a combination both of sensory and motor paralysis. Sometimes the motor paralysis affects one limb more than the other, and there may be a similar distribution of the anæsthesia.

The alternate paralysis of the face on one side, and of the limbs on the opposite, occurs more particularly with lesions of the pons situated towards the pyramids, at a point where the facial roots have not crossed over to pass on to the opposite hemisphere. If the lesion be higher up, near the crus cerebri, the face and limbs may both be paralysed on the side opposite the lesion. Amongst other varieties the face alone may be paralysed, without affection of the limbs; or one side of the face may be paralysed, and the other in a state of spasm; or both sides of the face may be paralysed; or one side of the face may be paralysed, and the limbs on both sides; or both sides of the face, and the limbs on one side. Spasms in the limbs paralysed or in the others may occur; and similar irritation of the sensory strands may be indicated by excentric hyperæsthesia and paræsthesia.

Along with the motor paralysis of the limbs, there is also a varying degree of vaso-motor paralysis, and a difference in temperature of the limbs of one degree or more.

Next in frequency to affections of the facial nerve, with or without affections of the limbs of the variable character above mentioned, comes affection of the abducens or sixth cranial nerve. This gives rise to an internal strabismus, and usually of the eye on the same side as the lesion. There may be, therefore, paralysis of the face and abducens on the side of lesion, and of the extremities on the opposite side; but cases have been recorded of paralysis of the abducens on one side, and of the face and limbs on the opposite;

and also of paralysis of the face, abducens nerve, and limbs on the same side as the lesion.

Defects in articulation are not unfrequently observed, depending on impaired mobility of the tongue, usually on the side of the motor paralysis of the limbs, but apparently sometimes on the other side. The fifth cranial nerve is also not unfrequently implicated. The sensory portion seems to suffer more than the motor. But cases have been recorded in which the motor portion of the fifth has been specially affected, leading to paralysis and degeneration of the muscles of mastication.

The affection of the sensory division shows itself in more or less marked anæsthesia of the face, which may be general or limited to the area of distribution of some of the branches only. The tongue is not unfrequently affected on the same side, and tactile and gustatory sensibility impaired or abolished on the anterior two-thirds. The affection of the fifth may occur on the same side as the lesion, with or without affection of the limbs, but it would appear also that anæsthesia of the face may occur, with implication of the extremities on the side opposite the lesion.

There is thus an extraordinary complexity and variability in the symptoms which may be met with in connection with pontine lesions. Those which have been mentioned are the most common and most significant, especially if they occur in combination. Singly they have less value, and some of them, particularly defects in articulation, are not specially characteristic. But a combination of paralysis of the limbs on one side, either motor alone, or of motility and sensibility, and of the face on the other, is significant of pontine lesion. The addition of paralysis of the abducens adds to the certainty.

Many other symptoms might be mentioned which have been noted in connection with lesions of the pons, especially tumours, which ought perhaps to be ascribed to interference with the functions of neighbouring structures. As in other parts, however, tumours have been found invading or pressing on the pons without having given rise to any marked symptoms during life. But at other times, along with one or more of the previously mentioned symptoms, impairment of deglutition has been observed, due without doubt to pressure on the medulla oblongata. To pressure on the medulla oblongata should also be ascribed the irregularity and ultimate paralysis of the cardiac and respiratory movements, in connection either with tumours or with hæmorrhagic effusions into the pons itself.

When a tumour presses forward in the direction of the crura cerebri, the third cranial nerves may be implicated. Ptosis has been observed in such cases; and external strabismus, from paralysis of the internal rectus, has also occurred, but comparatively rarely.

Vertigo and disorders of equilibration have also been observed, but these may be attributed to an implication of the cerebellum or of its peduncles. Ataxic symptoms have, however, been described by Leyden as occurring in pontine lesions, without affection either of the cerebellum or of its peduncles. The writer has seen a case of very marked ataxy associated with anæsthesia of one side of the face, and of the limbs and trunk on the opposite side, due probably to lesion on the right side of the pons. But the cases which have been recorded are not yet sufficient to establish any very definite propositions in regard to the exact causation or special characteristics of the ataxic disorders in question. In connection with tumours pressing on the pons, hearing may also be impaired or abolished in one or both ears. Impairment of smell has been observed on one side, when there has been anæsthesia of the face. This is probably due to the impairment of common sensibility in the nostril, intensified in some cases by the defective power of sniffing if the facial nerve is also paralysed.

Albuminuria and glycosuria have occasionally been found in connection with diseases of the pons. It is very doubtful if any causal relationship has been at all satisfactorily established. Very often when albumin has been found, there is good reason to believe that it has been pre-existing, for lesions of the pons frequently occur in connection with chronic renal disease. Sugar has been found sometimes, and in other cases not. The same has been found in connection with lesions of other nerve-centres. So far, therefore, as facts go, the evidence in favour of a direct relationship between pontine lesions and glycosuria is at present extremely slender, and in need of further investigation.

Diseases which encroach on the intracranial space produce the general symptoms of intracranial tumour, in addition to the special symptoms indicative of their invasion of the pons.

D. Ferrier.

**PORRIGO LARVALIS** (*porrigo*, scurf, and *larva*, a mask).—*Porrigo* is an old-fashioned term, applied generally to eruptions on the scalp and face, whether exudative or desquamative; *larvalis*, masked, alludes to the covering of the face with an incrustation which conceals the features like a mask, such as is seen in a neglected exudative eczema of the face, an eczema pustulosum or impetiginodes. Pathologically, porrigo is an eczema. *See* Eczema.

**PORTAL OBSTRUCTION.**—This is a condition of not uncommon occurrence, and calls for brief general discussion. Strictly speaking, portal obstruction implies that there is some direct impediment to the flow of blood in the portal circulation, either affecting the trunk of the vein before it enters the liver, or its branches in the substance of this organ. It must be remembered, however, that any condition that interferes with the circulation beyond the portal divisions, whether in the hepatic vein, inferior vena cava, right side of the heart, or lungs, will retard more or less the flow of blood through the portal system; and also that either of the tributary branches of the portal vein may be affected alone. The portal trunk may be obstructed by direct pressure upon it, as by enlarged glands, a growth projecting from the liver, or a neighbouring tumour; by changes in its walls, leading to constriction or complete closure; or by blocking-up of its channel, as by a thrombus (*see* Portal Thrombosis). Cirrhosis is the most important disease which obstructs the portal circulation within the liver; but this result may also arise from accumulation of pigment and other causes.

Effects.—The effects of portal obstruction will depend on its seat, its degree, and the rapidity with which it is set up. They are merely those which necessarily follow mechanical venous congestion, namely, distension of the small vessels, which may end in changes in their walls and varicosity; escape of serum; a catarrhal condition of mucous surfaces; hæmorrhages; and, in course of time, permanent changes in organs and structures which are congested. Their localisation in this case will correspond to the structures from which the portal vein receives its tributary branches. Hence any of the following conditions may result in various degrees from portal obstruction: —(1) Congestion and catarrh of the mucous membrane lining the stomach and intestines, with consequent disorder of the secretions; dilatation and varicosity of the small vessels; or hæmorrhage into the alimentary canal. (2) Ascites, one of the most frequent and evident phenomena. (3) Enlargement of the spleen, either from mere accumulation of blood, or in chronic cases with permanent increase and alteration in the splenic structure. (4) Congestion, followed by fibroid changes in the pancreas. (5) Hæmorrhoids, it is generally believed. (6) After a while enlargement of the superficial veins of the abdominal wall, owing to their communications with the portal vein; as well as of the veins within the abdomen, which are tributary to it.

Several of the conditions mentioned are obvious on clinical examination during life; others are only evident on *post-mortem* examination, although they assist in originating symptoms, especially in connection with the alimentary canal, such as those of dyspepsia, flatulence, and disordered bowels. Hæmorrhage into the stomach or bowels is usually revealed by the occurrence of hæmatemesis or melæna, but it may prove fatal without any discharge of blood externally. It must necessarily happen that if the portal circulation is not properly carried on, the functions of the liver are proportionately disturbed.

The signs of portal obstruction may set in with great acuteness, or very gradually. Those indicative of acute obstruction are the rapid development of ascites, returning speedily after paracentesis; enlargement of the spleen; and hæmorrhage into the alimentary canal. It must be remarked that the most striking phenomena may disappear in chronic cases, after a time, without the removal of the obstruction, probably owing to the development of new channels, by which the blood is returned to the heart without passing through the liver.

Diagnosis.—There ought to be no difficulty in recognising the signs of portal obstruction in marked cases; and it might even be suspected before these signs are well-developed under certain conditions. The cause of the obstruction can only be made out by a consideration of each case in all its features.

Treatment.—Rarely can anything be done directly to remove portal obstruction. The circulation may often be relieved to some extent by acting freely upon the bowels, especially by means of saline and hydragogue purgatives. Treatment directed to the effects of portal obstruction is frequently highly efficacious, and the most important of these may be cured or relieved, even though their cause remain unaffected. The special treatment of these symptoms, and also of the conditions upon which portal obstruction depends, is described in other articles.

Frederick T. Roberts.

**PORTAL THROMBOSIS.**—Synon.: Portal Phlebitis; Pylephlebitis; Fr. *Pyléphlébite*; Ger. *Pylephlebitis*.

Portal thrombosis may be divided into two kinds: (*A*) the **Adhesive**; and (*B*) the **Suppurative**.

(*A*) **Adhesive Portal Thrombosis.**—Adhesive portal thrombosis is seen most commonly in cirrhosis of the liver, rarely as a cause of the cirrhosis itself. In the first case, it arises, not from an inflammation of the walls of the vessel, but from obstruction to the circulation. The thrombus itself is usually firmly adherent to the walls, tough, and of a red-brown colour, the vein being dilated.

Symptoms.—The symptoms of portal thrombosis are those of intense portal obstruction. There is ascites, rapidly developing itself, and, according to Frerichs, returning rapidly after removal by tapping. The veins of the walls of the belly become dilated. There may be hæmatemesis or a bloody diarrhœa. The spleen is greatly enlarged. Jaundice may or may not be present.

Diagnosis.—The diagnosis of portal thrombosis is a matter of great difficulty, the symptoms being very like those of cirrhosis, of which, indeed, it is often a mere complication.

Prognosis and Treatment.—The prognosis is always bad, no instance of recovery being known, and the treatment must be the same as for cirrhosis.

(*B*) **Suppurative Portal Thrombosis.**—Suppurative portal thrombosis is commonly met with in connection with some morbid process, most often suppuration, in the parts from which the branches of the portal vein arise, as the intestines, of which very often the cæcum is the seat, next the stomach, and the spleen. The vein is found greatly dilated, and filled with a dirty grey or reddish pulp, which, under the microscope, shows small round nucleated cells like pus-corpuscles. The liver itself shows, on section, the branches of the portal vein filled with a diffluent thrombus, so that the organ looks as if pervaded with abscesses.

Symptoms.—The symptoms closely resemble those of abscess of the liver or of pyæmia. Traube thinks the diagnosis may be made if the liver and spleen be much enlarged, and if there be returning attacks of rigors with raised temperature, while between the attacks the temperature is natural or only slightly raised. There must be also evidence of some suppuration, which may involve the branches of the portal vein; and pyæmia and endocarditis must be excluded. Often, however, all these signs fail.

Prognosis and Treatment.—The prognosis is always bad; the treatment must be the same as for abscess of the liver or pyæmia.

J. Wickham Legg.

**POST-MORTEM EXAMINATION.** *See* Necropsy.

**POST-MORTEM WOUNDS.**—Synon.: Dissection-wounds; Fr. *Blessures anatomiques*; Ger. *Sectionwunden.*

Definition.—A variety of poisoned wounds, arising from the inoculation of a virus derived from the dead bodies of men or animals.

Similar consequences may result from the inoculation of the discharges from unhealthy inflammations in living bodies, especially those arising from *post-mortem* poisoning. The conditions necessary for the production of a dissection-wound are the virus, a means of entrance of the virus into the system, and a condition of body favourable to the development of the effects of the virus.

Pathology.—*The Virus.* Of the exact nature of the poison which gives rise to *post-mortem* wounds we know but little. The products of ordinary decomposition may cause local troubles, to be mentioned hereafter, but they never give rise to the graver forms of dissection-wound. The poison is present in greatest intensity in fresh bodies, and its virulence diminishes as decomposition advances. We have no evidence that it is the same in all cases, and as the effects vary greatly, we are justified in assuming that the poison also varies. The chief views held as to its nature are, that it is a product of a certain stage of ordinary decomposition; that it is the product of some special non-organised ferment; and that it is of the nature of a minute organism, which has the power of propagating itself in the living body. The first view is probably untrue, as the poison which gives rise to serious dissection-wounds is only found in the bodies of patients who have died from some unhealthy inflammatory (infective) process. It is most marked in cases of septic peritonitis or pleurisy, pyæmia, septicæmia, puerperal fever, diffuse cellulitis, erysipelas, or spreading gangrene. The diminution of the intensity of the poison with decomposition is accounted for on the second theory, by supposing that the peculiar ferment is destroyed by putrefaction; and on the third theory, by the specific organism being destroyed by the growth of the ordinary bacteria of decomposition, it being a well-known fact that when two organisms are growing together in the same fluid, the stronger seems to overpower the weaker, to check its growth, and finally to lead to its destruction.

Certain specific diseases, as glanders and splenic fever (malignant pustule), may be communicated by inoculation from the dead body, but these accidents are not classed with ordinary dissection-wounds.

*Mode of entrance of the poison into the system.* Whatever the virus may be, it only acts by direct inoculation. This most commonly occurs through an accidental wound or scratch during the *post-mortem* examination; but a raw surface partly healed, or the fissures in chapped hands, or the small fissures so common at the margin of the nail, may equally serve as points of inoculation. In rare cases infection takes place through the unbroken skin, the hair-follicles seeming then to serve as the points of entrance. The further progress of the poison takes place either by soaking amongst the lymph-spaces of the cellular tissue, as shown by diffuse spreading cellulitis; or by being carried with the stream in the lymphatic vessels, as in those cases in which the local affection is slight, and the first trouble is in the lymphatic glands.

Prevention.—In order to prevent inoculation the following points should be attended to. Before making a *post-mortem* examination of a dangerous case the hands should be carefully looked over. If any spot denuded of cuticle is found on the fingers, an india-rubber cot should be applied, its base being bound round with string. If the whole hands are sore and chapped an india-rubber glove may be used. If no india-rubber cot for a finger is to be found, an efficient water-proof covering may be made at once with gutta percha tissue and chloroform. If the hands are sound they may be well greased with carbolic oil (1 to 10), but, as this soon wipes off, the application must be repeated several times during the *post-mortem* examination. Accidental wounds arise almost invariably from carelessness—the assistant being as often wounded as the operator. There is scarcely any operation in a *post-mortem* which requires two to perform it, and an assistant should therefore be dispensed with. The most common acts of carelessness are—cutting towards instead of away from the left hand; and letting the knife fall unobserved into one of the cavities, where it is concealed by blood or the viscera, and wounds the hands when next introduced. Wounds from ribs are amongst the most dangerous, as they bleed but little. To avoid these, when the bone-forceps has to be used, in cases of ossification of the cartilages, the ribs should be cut near the nipple line, and the skin folded over them whilst the viscera are being examined. In opening the head the saw is apt to slip, and to injure the hand holding the vault. To avoid this, either wrap the hand in a thick cloth, or hold the head with the left hand on the face, where it will be out of danger. Punctures during the sewing-up of the body have caused many deaths. These injuries are usually due to using too small a needle, which cannot be kept properly under control. A common packing needle sharpened is by far the safest instrument that can be used. In whatever way the wound is made the first essential of treatment is to make it bleed freely. If it is on the finger this may be done by winding a piece of string round it from the root to the tip; then wash it thoroughly under a tap and suck it. Caustics are quite unnecessary if these directions are carried out. After a *post-mortem* examination the hands should always be well washed in some strong antiseptic solution.

*The condition of body favourable to the development of the effects of the poison.*—Nothing is more common than for two persons to be wounded at the same *post-mortem* examination, and only one to suffer from it. Sir James Paget has brought forward strong evidence for believing that constant exposure to the poison gives a certain degree of 'immunity from the worse influences of the virus,' and that one dissection-wound protects the sufferer from another, at least for some time. Anything which causes a depressed state of health favours the occurrence of *post-mortem* poisoning. Thus, we see it in students who have been some months resident in hospital,

in nurses who are worn out with attending a bad case, and in dissecting porters or others who indulge too freely in alcohol. Beyond these no special predisposing conditions are known. *See* PREDISPOSITION TO DISEASE.

VARIETIES.—It will be convenient to discuss the several forms of *post-mortem* wounds under distinct headings according to the following arrangement:—

**1. Purely Local Affections.**

(*a*) *Dissecting-porter's wart*, or *anatomical tubercle.*—Although not exactly a *post-mortem* wound, this affection must be mentioned here as being one of the effects of the irritation caused by the repeated application of putrid matter to the skin. It is seen only in those whose occupation brings them much in contact with decomposing animal matter, and is of very rare occurrence. Its seat is always at the back of the hand over the knuckles, or the joints of the fingers. It is characterised by a warty thickening of the skin, which may in some cases resemble epithelioma. In other cases the thickening of the cuticle may give the skin an ichthyotic appearance. The enlarged papillæ are set closely together, and there is no true ulceration, but cracks and fissures may exist in parts, from which a serous discharge escapes. The growth tends slowly to spread. These warty growths are usually multiple, and this, together with the want of any tendency to ulceration, will serve to distinguish them from epithelioma.

TREATMENT.—In some cases a cure can be effected by the constant use of wet dressing to soften the epithelium, combined with the application of a mixture of equal parts of glycerine and extract of belladonna. Should this fail, painting with strong tincture of iodine may be tried, or, as a last resource, the application of some strong caustic.

(*b*) *The dissecting-room pustule.*—This is always the result of the inoculation of some poisonous matter into a slight abrasion or puncture. About twenty-four hours after inoculation the spot becomes red and itches. In another twenty-four hours a small drop of pus is seen raising the cuticle, and the part is intensely tender. If the drop of pus be let out the pain is at once relieved. If no treatment be now adopted to prevent it, a small scab forms, under which pus again forms, and the redness and pain return as before. Each time that this happens the sore increases in size, till it may reach about one-eighth of an inch in diameter, and it then closely resembles in appearance a small soft chancre. Without treatment the condition may continue indefinitely. It is very seldom accompanied by any constitutional disturbance. The axillary glands may be tender, but suppuration is rare, except in unhealthy subjects.

TREATMENT.—The small pustules can usually be cured simply by the application of water-dressing, so as to prevent the formation of a scab, and the shutting in of the pus. The treatment must be continued until it is soundly healed. If the smallest speck is unhealed it will relapse as soon as the dressing is removed. If, in spite of water-dressing it refuses to heal, nitrate of silver may be applied, or the ulcerated surface may be covered with iodoform.

(*c*) *Suppuration of the matrix of the nail.*—This arises from inoculation through one of those small fissures at the side of the nail popularly known as 'agnail' or 'hangnail.' The inflammation extends rapidly to the matrix at the root of the nail. The dorsal aspect of the finger for half-an-inch below the nail is swollen, red, and acutely tender, and on pressing over this area pus oozes out over the nail. The inflammation rarely extends over the whole matrix, so that the distal part of the nail is usually unaffected and firmly attached, while the root is softened and loosened by the suppuration beneath it. The discharge has a strong, offensive odour of decomposition. This condition is extremely chronic, the irritation being kept up almost indefinitely by the putrid discharge, which is more or less pent up beneath the nail. When recovery takes place the nail usually separates.

TREATMENT.—The first essential of treatment is, if possible, to render the discharges aseptic. For this purpose the finger may be soaked in a concentrated solution of boracic acid, and dressed with boracic acid lint; or powdered iodoform may be pushed with a piece of card beneath the swollen skin over the root of the nail. If these fail a strong solution of subacetate of lead (liquoris plumbi subacetatis, 1 part, spiritûs rectificati 1, aquæ 6,) may be tried. If all these simpler means fail, the nail must be removed, and the raw surface, dressed with some mild antiseptic lotion, will quickly heal.

(*d*) *Suppuration of the hair-follicles.*—This is a somewhat rare effect of *post-mortem* poisoning. About forty-eight hours after exposure to infection a varying number of small pustules, each surrounded by a red areola, form on the hairy parts of the hands and wrists. On careful examination each pustule will be seen to have a hair passing through it. As a rule these pustules discharge and dry up without causing further trouble, but in some exceptional cases they may be followed by constitutional symptoms or lymphatic inflammations.

TREATMENT.—All that is necessary is to cover the part with cotton-wool, to hasten the drying of the pustules.

(*e*) *Boils.*—Boils, which differ in no respect from those arising without known cause, may form as a consequence of exposure to *post-mortem* poisons. They probably start from inflammation of the hair-follicles.

TREATMENT.—This presents nothing special.

(*f*) *Ordinary Whitlow.*—Although whitlow is common amongst nurses and others whose duties oblige them to dress foul wounds, it is a very rare consequence of *post-mortem* wounds. It may, however, occasionally be met with and then present nothing special. *See* WHITLOW.

**2. Diffuse Inflammation of the Cellular Tissue, spreading from the point of inoculation.**

(*a*) *Diffuse Cellulitis.*—The seat of inoculation becomes in from twelve to twenty-four hours more or less red and irritable, and in this state it may remain for another day, at the end of which time a brawny swelling of a dusky red colour forms round it, and rapidly extends in all directions, but chiefly in the line of the lymph-stream. At the same time there is intense tension, burning pain, and severe constitutional

disturbance, high temperature, total loss of appetite, and possibly delirium. Red lines of inflamed lymphatic vessels may or may not be seen extending upwards, but glandular abscesses are rare, as in ordinary cellulitis. If unrelieved by treatment, sloughing rapidly follows the brawny swelling, first of the subcutaneous tissue, and afterwards of the skin.

Treatment.—The only treatment in such case is free and early incision into the affected part. In one case which came under the observation of the writer the inoculation took place from a scratch from a broken rib which had penetrated a consolidated lung, and caused the formation of a foul abscess. Swelling in the finger commenced on the second day, about 10 p.m., and at 11 a.m. on the following morning it had involved the whole finger and part of the back of the hand. Red lines extended from it a little way above the wrist. Two incisions were immediately made in the palmar aspect of the finger, and one on the dorsum of the hand, with the effect of at once arresting the extension of the process. In this case the attack commenced with slight nausea, but no chilliness or rigor; there was high fever and delirium on the third and fourth days. The constitutional treatment must be the same as in other cases of diffuse cellulitis. *See* Erysipelas.

(*b*) *Spreading Gangrene.*—This is an intensification of the preceding variety. A red, brawny swelling advances rapidly up the arm, quickly followed by gangrene of the subcutaneous cellular tissue and skin. This condition is extremely rare as a consequence of dissection-wounds. A case occurred in 1880, at University College Hospital, under the care of Mr. Heath, in which the patient's life was only saved by amputation at the shoulder-joint. It happened to a nurse from an accidental wound received whilst laying out the body of a patient who had died of puerperal fever.

Treatment.—The treatment is the same as in other cases of spreading gangrene.

**3. Inflammations chiefly affecting the Lymphatics.**

(*a*) *Inflammation of the Lymphatic Vessels.*—This usually commences from twenty-four to forty-eight hours after inoculation. The seat of inoculation may show scarcely any signs of inflammation, or it may have developed into a small suppurating sore. The invasion of the lymphatic inflammation is marked by elevation of temperature, chilliness, or possibly a rigor. There is malaise and often nausea, with headache. Red lines are soon after observed running upwards from the seat of inoculation in the course of the lymphatic vessels. These lines are about one-eighth to one-quarter of an inch in width, and clearly defined. They are acutely tender. The lymphatic glands to which they lead are swollen and painful. If unrelieved by treatment suppuration frequently occurs in the lymphatic glands, or sometimes in the course of the vessels. Occasionally several lines may fuse together, giving the appearance of a band of cutaneous erysipelas.

Treatment.—The bowels should be well opened. Stimulants in moderate quantities may be taken, good port wine being especially useful, with strong beef-tea, milk, and eggs. If there is much fever quinine may be of use in reducing the temperature. Locally, the whole course of the inflamed vessels is to be painted with a mixture of glycerine and extract of belladonna in equal parts, and the whole arm wrapped in hot fomentations, which must be frequently renewed. This treatment seldom fails to arrest the progress of the inflammation, and ward off suppuration. If pus forms, either in the course of the vessels or in the glands, it must be let out as soon as it is recognised.

(*b*) *Abscess in the Lymphatic Glands.*—This occurs either as a consequence of the previous condition or without any evident inflammation of the lymphatic vessels. It is frequently a complication of one of the local forms first described. The abscess forms either in the gland at the bend of the elbow or in the axilla, and presents no special features requiring description. The prognosis is not grave.

Treatment.—The abscesses must be opened as soon as recognised, and, if possible, treated antiseptically.

(*c*) *Axillary Cellulitis.*—This is one of the gravest effects of *post-mortem* wound. It frequently occurs in cases in which the local affection at the seat of inoculation is so slight as to be scarcely recognisable. From twenty-four to forty-eight hours after inoculation the patient is seized with chilliness, and frequently a rigor; there is great depression; with nausea, or even vomiting, and headache. The temperature rapidly rises, reaching 104° or 105°, and there is frequently delirium. On examining the axilla some fulness, with acute tenderness, is recognised, and there is pain in moving the arm. The fulness soon extends to the front of the chest, in the region of the pectoralis major, and the veins of the region may become more clearly visible than natural. Later on there may be a blush of redness over the pectoral region, and with this there is œdema. If not relieved the swelling and redness may extend down the side of the chest, and show above the clavicle at the root of the neck. The constitutional condition assumes the ordinary characters of septicæmia. There is muttering delirium, rapidly failing pulse, dry tongue, with sordes on the lips and teeth, possibly diarrhœa, and the patient sinks into a comatose condition and dies. Sir James Paget, in his well-known lecture on his own case, explains this condition by supposing that the lymphatic glands are first swollen, and the flow of lymph through them obstructed, and that the poison then extends backwards in the distended lymphatics till it reaches the cellular tissue in which they arise, thus causing diffuse cellulitis, which, if not relieved, or if not speedily fatal, may extend to the whole area which sends lymph to the affected glands. If an incision be made early into the affected cellular tissue it will be found merely infiltrated with serum; later on the serum is turbid; still later the whole areolar tissue would be found in a sloughy condition, soaked in pus.

Treatment.—The blood-poisoning accompanying this condition is frequently fatal in spite of any treatment. The only hope for the patient lies in early recognition of the state of the part,

and in making free incisions. These incisions must thoroughly open up the axillary fascia, and if there is any suspicion of extension beneath the pectoralis major, another incision must be made two, or even three, inches in length, through the muscle. This is best made in the interval between the sternal and clavicular portions. The skin and fat only need be divided with the knife, the muscular fibres being separated with the handle of the scalpel to avoid hæmorrhage. If these incisions are made with all antiseptic precautions and the antiseptic dressing adopted, the patient's chance of life is greatly increased. The constitutional treatment consists in free stimulation and abundant nourishment. Quinine may possibly be useful in large doses.

4. **Septicæmia.**—In some cases, which, fortunately, are very rare, *post-mortem* wounds prove speedily fatal, with the ordinary symptoms of acute septicæmia. Local changes at the seat of inoculation may be entirely wanting.

5. **Pyæmia.**—Pyæmia may occur as a secondary complication of the forms of *post-mortem* wound which are accompanied by suppuration and sloughing; but it presents nothing special in such cases. *See* PYÆMIA.

MARCUS BECK.

**POST-PHARYNGEAL ABSCESS.** *See* RETRO-PHARYNGEAL ABSCESS.

**POSTURE.**—In this article it is intended to point out the main practical relations of posture to the ætiology, diagnosis, and treatment of various diseases. It not uncommonly happens that a patient assumes instinctively a posture by which his condition may be at once recognised, or which gives indications of importance as to his management. In other cases the practitioner makes systematic use of posture to assist him in his diagnosis, or to aid him in treatment. It should be mentioned at the outset that persons often present peculiarities with reference to posture, which are of no practical significance, and are the result either of natural differences in individuals, or of habit. For instance, some people can only sleep with the head raised very high, in an almost semi-recumbent position; others lie with the head very low, even level with or below the body. Many are unable to sleep on the back, or on one or other side, and especially the left side. The subject will be further discussed in its relations to the points mentioned above.

1. **Ætiology of Posture.**—As an immediate cause of disease, posture is chiefly important in connection with occupation. For instance, many persons suffer from long-continued standing; or, on the other hand, from sedentary occupations. The evil effects of the erect posture are evidenced by the development of varicose veins in the legs, and also by the occurrence of general fatigue and debility, displacement of the uterus, and other conditions, especially in young women; and this subject has of late received considerable attention in relation to those employed in drapers' shops. Those callings which entail constant or frequent bending forward of the body are often very injurious, and this may be aggravated by carrying burdens on the back and shoulders. Not uncommonly persons injure themselves by habitually bending forward while sitting, quite apart from occupation. Another illustration of the influence of posture in causing disease is where individuals have to work in constrained positions, such as colliers and mine-workers. The conditions thus induced are chiefly deformities of the chest, and certain diseases of the lungs, heart, and vessels. Posture is also of consequence in predisposing to certain affections under particular circumstances, or in modifying their effects. Thus the recumbent posture in low febrile and other conditions aids in the causation of hypostatic congestion and its consequences; a similar position promotes the accumulation of morbid products in the bronchi in cases of acute bronchitis, which may cause further mischief; and if an attack of pleurisy should supervene when a patient is obliged to lie on his back, this will materially modify the way in which the fluid accumulates, for it tends then to collect posteriorly, and may cover the whole area of the chest in this aspect, while there is no sign of any fluid in front. Lastly, a peculiar posture in performing certain acts, such as writing, may have some influence in originating affections of the type of writer's cramp.

2. **Posture in Diagnosis.**—As examples of postures spontaneously adopted by patients, which may give useful information in diagnosis, the following are the most striking. In many cases the posture indicates great debility, helplessness, or prostration, and may thus afford important information as to the general condition of a patient. An inability to lie down constitutes a prominent feature in certain forms of cardiac and pulmonary disease, in consequence of interference with the respiratory functions, so that the patient is obliged to sit or to be propped up in bed, or sometimes even to sit up in a chair, to assume the erect posture, or to bend forward. Again, when anything is pressing upon the main air-tube—such as an aneurism—causing obstructive dyspnœa, the patient may instinctively lean forward, so as to take off the pressure as much as possible. In cases of unilateral lung-disease or pleurisy, the patient is often unable to lie on one or other side, especially the affected one; while in affections of the heart it is frequently impossible for him to rest on the left side. As regards abdominal diseases, acute peritonitis is usually characterised by a very striking posture, the patient lying on his back, with the knees well drawn up and bent, in order to relax the abdominal muscles. He may also assume certain positions in other abdominal affections, on account of their influence upon symptoms, such as pain or vomiting. In spasmodic painful attacks connected with this region, it is very common to see the patient bending forwards in a doubled-up position, and pressing upon the abdomen. In nervous diseases posture may be of value in diagnosis. Thus, it may reveal paralysis of different parts; in cerebral meningitis the patient often lies in a curled-up position, all the limbs being bent towards the body; in spinal meningitis the head may be involuntarily drawn backwards, in order to try to relax the muscles behind; in cataleptic conditions any posture that is assumed is retained for a considerable or an unlimited time; while in wry-neck the head is

turned to one side. Lastly, the position voluntarily assumed by a limb may give important information as to local diseases likely to influence it in this respect, such as those of the joints. The whole body may be distorted, as well as the limbs, in connection with diseases of the articulations.

What has just been stated will supply hints as to how the practitioner might avail himself of alterations in posture in aiding him towards a diagnosis in certain cases. For instance, observing the effect of such changes often gives valuable information in connection with pulmonary and cardiac diseases, as evidenced by the influence of the respective positions upon breathing, cough, the heart's action, and other symptoms; and the same may be the case in some abdominal diseases, as well as in nervous affections or in local diseases. Change of posture is most useful, however, in connection with physical examination, the effects it produces upon certain physical signs being noted. In this way it is of essential aid in determining the presence of fluid in cavities, such as the pleura or peritoneum; in distinguishing an internal aneurism from conditions simulating this lesion; in detecting certain solid formations in the abdominal cavity; and for other purposes. Details on these points are given in other appropriate articles. It is also of importance to study the position of the patient in examining the chest; and to remember that posture may materially influence physical signs connected with the heart.

3. **Posture in Treatment.**—Many of the preceding remarks will afford suggestions as to the value of paying attention to posture as a therapeutic measure, and it will at once be evident that if a wrong posture is the cause of any morbid condition, the first principle in treatment should be to rectify it. Besides, it will not uncommonly be found advantageous to watch patients, and to allow them to adopt, or assist them in adopting, such a position as their own sensations dictate to be the most suitable for their condition. In order to illustrate further, however, the benefits to be derived from posture, it may be well to point out some of the diseases in which its value is most strikingly exhibited.

(*a*) Posture is of great importance when general rest of the body is required, or when there is general exhaustion or prostration of the system. The recumbent posture is clearly indicated under these circumstances, for it is the most restful of all, and involves little or no expenditure of muscular force. Hence in acute febrile diseases of all kinds, one of the first indications in treatment is to keep the patient absolutely in bed. This is also desirable where there is excessive fatigue or prostration from any cause.

(*b*) In the management of affections connected with the respiratory organs, attention to posture is frequently of service. Here its influence as regards rest again comes in, for it may be of much consequence to make as little call as possible upon the respiratory functions. Moreover, symptoms associated with the breathing apparatus are in many cases strikingly influenced by posture, such as pain, dyspnœa, or cough; and the act of coughing may be materially assisted, and made more effectual as regards expectoration, by the patient assuming a sitting or erect position. The importance of the prone posture, or of bending forwards, must be remembered when there is anything pressing on the main air-tube.

(*c*) Posture often requires particular consideration in relation to disorders of the cardiac action, or to actual disease of the heart. Thus, in the syncopal state the patient should be placed horizontally, or even with the head at a lower level than the body, so that the blood may more readily reach the brain, and thus life may be sustained. In this state, or when the heart is acting with extreme feebleness from any cause, raising the patient into a sitting posture has been known to cause a fatal result, and should be carefully avoided. On the other hand, there are conditions of the heart in which the patient cannot possibly lie down, and especially where there is much dilatation; under these circumstances it may be of the greatest service to have him constantly sitting up in a properly-constructed chair, and the beneficial effects thus produced are sometimes almost marvellous.

(*d*) In the treatment of aneurisms, whether internal or external, posture is frequently made use of with advantage. In the cure of this lesion in the chest or abdomen, rest is often an important agent, and on this account patients are kept in the recumbent posture for weeks or months, so as to keep the heart as quiet as possible, and also to limit the demand of the system for food, which is only given in a restricted quantity. Aneurism in the chest is one of the causes which may originate pressure on the air-tube, and on this account attention to posture may be required in connection with it. In the case of aneurism in the limbs, posture is sometimes made use of to cure them, by causing pressure, as flexion of the knee for the cure of popliteal aneurism.

(*e*) The influence of posture with respect to gravitation may often be recognised with advantage in the treatment of certain conditions. This is well exemplified by its effects on dropsical accumulations in the legs and scrotum. Abundant anasarca may frequently be got rid of completely in a short time by keeping the legs in a horizontal position; and œdema of the scrotum likewise may soon disappear when this part is propped up. The same principle is of essential importance in checking hæmorrhage from a ruptured varicose vein in the leg; and may also be made use of in the cure of varicose veins. The influence of posture upon dropsy may give useful information as to its cause, and as to the exact conditions upon which it depends.

(*f*) As miscellaneous illustrations of the employment of posture in treatment may be mentioned the value of the recumbent position in sea-sickness, attacks of giddiness, megrim, and neuralgic affections about the head; raising the head in comatose conditions; the prone posture in the treatment of certain forms of spinal disease; prolonged decumbency to restore a displaced uterus; and various positions in which limbs are placed on account of local diseases, to relieve pain, to prevent muscular tension, to promote the escape of pus, or for other purposes.

(*g*) Lastly, it must be remembered that it is

not uncommonly requisite to change the position of a patient more or less frequently, if he should be confined to his bed. For instance, it may be necessary to do this in low febrile diseases, in order to prevent the occurrence of hypostasis at the bases of the lungs, or the formation of bed-sores on parts subjected to pressure. This is also necessary in many cases of spinal or cerebral disease, and in very emaciated patients (*see* Ulcer). Change of posture is further useful in assisting the escape or expulsion of morbid secretions from the air-passages when they tend to accumulate there. Frederick T. Roberts.

**POUGUES, in Loire, France.**—Alkaline chalybeate waters. *See* Mineral Waters.

**POULTICE.**—Synon.: Cataplasm; Fr. *Cataplasme*; Ger. *Breiumschlag*.—Poultices are soft moist applications, usually applied hot, but occasionally cold. They may be used merely as a means of applying heat and moisture; or may contain some drug intended to exert a specific effect. Of the innumerable poultices formerly in use, only six are now officinal.

Poultices may be arranged thus: 1.—The *simple* poultice, composed of linseed meal. The practice of using bread soaked in hot water as a poultice has deservedly fallen into disrepute, as it soon becomes sour and offensive. 2. *Disinfecting* poultices, namely, cataplasma carbonis, and cataplasma sodæ chloratæ. 3. *Sedative* poultices, such as cataplasma fermenti, and cataplasma conii. 4. The *counter-irritant* poultice—for example, cataplasma sinapis.

1. **Simple Poultice.**—The simple poultice, by its heat, causes a dilatation of the vessels of the part to which it is applied, and thus hastens the progress of inflammation, either towards resolution or suppuration. It softens the cuticle, and relaxes the skin by its moisture, and thus favours swelling, and lessens tension and pain. In internal affections, such as bronchitis, pleurisy, or pericarditis, large poultices are frequently applied to the skin over the inflamed part. They benefit the patient, partly by their warmth, and partly by exerting an extremely mild counter-irritant effect, consequent upon the redness and congestion of the skin which they produce. They are, however, somewhat troublesome; they soon become cold and hard; and if the patient be restless their weight causes them to shift, and fragments break off and drop into the bed, and there drying they cause considerable discomfort. For application to external inflammations a few folds of lint, soaked in hot water or any appropriate lotion (sedative, stimulant, or antiseptic), covered with oil-silk, and afterwards with a thick layer of cotton wool, will be found to answer every purpose of a poultice, and to be much more cleanly and less troublesome.

Linseed-meal poultices applied to boils usually cause a fresh crop to spring up round the original boil, from the irritation they give rise to. They should consequently never be used, wet boracic lint being always substituted. In internal inflammations a poultice may often be advantageously replaced by cotton-wool only, covered with oil-silk and secured by a bandage. If any counter-irritant action is required a few drops of chloroform or turpentine may be sprinkled on the wool.

Linseed-meal poultices are best made from meal from which the oil has been expressed, as the pure meal becomes rapidly rancid. The *British Pharmacopœia* recommends the addition of a little olive oil. The following is a useful method of making a linseed-meal poultice:—Heat the basin in which the poultice is to be made with boiling water; then empty it and put into it again as much boiling water as may be necessary to make the required poultice; sprinkle the meal into the water, stirring vigorously, till the proper consistence is attained; lastly, stir in a small quantity of olive oil. By adopting this plan the poultice will be free from lumps. The poultice should then be spread with a broad spatula on a piece of rag. It must be of a uniform thickness, and neither so thick as to be too heavy, nor so thin as to cool and dry too rapidly. A poultice should be changed every two or three hours by day, and every four at night, if the patient is sleeping. In all cases where there is free suppuration, a poultice is the dirtiest application that can be made to the wound. Wet boracic lint should always be used instead.

2. **Disinfecting Poultices.** — *Cataplasma carbonis* is a horrible compound of wood-charcoal, linseed meal, and bread, and was formerly supposed to have some disinfectant properties. Both this and the *cataplasma sodæ chloratæ* have been entirely replaced by more cleanly or efficient antiseptic applications. The best of these are boracic acid lint and carded oakum. If carded oakum be used it must be made into a soft and even pad, and may be dipped in hot water before being applied. It is a most powerful antiseptic, and very cheap, but it has the disadvantage of blackening the skin with the tar it contains, and sometimes causes considerable irritation. Both these inconveniences may be overcome to a certain extent by greasing the skin with carbolic oil (1 to 10).

3. **Sedative Poultices.**—*Cataplasma fermenti* is composed of beer yeast, 6; flour, 14; water (100° F.), 6. After mixing it is to be placed near the fire till it rises. The carbonic acid was credited with both sedative and antiseptic properties. It was chiefly used in boils, but from personal experience the writer can state that it has none of the virtues attributed to it. *Cataplasma conii* is composed of hemlock leaf, 1 ounce; linseed meal, 3 ounces; and boiling water, 10 ounces. Mix the ingredients and add them to the water gradually, constantly stirring. It has been chiefly used in cases of cancer to relieve pain. Its dirtiness and weight are, however, strong objections to it.

4. **Counter-irritant Poultice.**—*Cataplasma sinapis*, the ordinary mustard poultice, is an invaluable counter-irritant. It is composed of mustard in powder, 2½; linseed meal, 2½; boiling water, 10. The linseed meal is to be mixed with the water, and the mustard added, constantly stirring. It must be remembered that mustard varies much in strength, and that since it has been made the object of the special attention of the authorities engaged in carrying out the Adulteration Act, its strength has consider-

ably increased. Its action should extend only to producing redness of the skin, but if kept on too long it will cause vesication, and has even been known to give rise to sloughing. The time a mustard poultice can be kept on varies from ten minutes to half an hour or more, according to the strength of the mustard. The guide most usually relied upon is the sensations of the patient. An ordinary patient is not likely to keep it on too long, as the smarting soon becomes unbearable. Patients who are much in the habit of applying mustard poultices to the same part —as, for instance, the front of the chest—acquire a singular power of resistance to the irritative action of the mustard. The mustard poultice is indicated whenever mild and rapid counter-irritation is desired. It is especially useful in bronchitis, and in muscular rheumatism, as lumbago, or pleurodynia. Rigollot's mustard-leaves, or the Chartæ Sinapis of the *Pharmacopœia*, are an excellent substitute for the mustard poultice. They are cleaner, more easily applied, and can be more accurately adapted to the spot required. They should always be used in preference when obtainable. MARCUS BECK.

**PRÆCORDIAL ANXIETY or OPPRESSION.**—SYNON.: Fr. *Angoisse*; Ger. *Präcordialangst.*

DEFINITION.—A paroxysmal sensation of constriction, attended with anxiety, referred to the præcordium.

DESCRIPTION.—Præcordial anxiety is a distressing sensation in the region of the heart, characterised by an irregular, rolling, tumbling, or falling motion, supervening on a feeling of constriction. It is accompanied by feelings of anxiety; by restlessness, which may pass into a state of extreme agitation; by a sensation of approaching syncope, with fear of death; and by chilliness passing into a cold clammy perspiration. Though there may be a soreness or dull aching, there is neither pain nor palpitation. The urine is not increased, but rather diminished. Sleep is impossible. The attack often comes on during sleep, and soon, perhaps, the restless anxiety necessitates rising from the couch and walking about; often flatulence oppresses, and gas is evolved, with relief to the symptoms. The attacks are paroxysmal, of varying duration. Præcordial anxiety appears to have no alliance with præcordial pain; it does not appear to be a simple neurosis, but dependent on some abnormal muscular condition, whereby the irritability of the heart is disturbed, caused, it may be, by deficient innervation, or by an impure blood failing to stimulate it to due expansion and contraction. The heart may not be altogether free from indications of more than functional disease.

TREATMENT.—During the paroxysm relief is generally obtained in locomotion, and in occasionally administering small amounts of some diffusible stimulant or warm carminative. In the intervals fresh air, attention to dietetic rules, the free evacuation of the bowels without purging, and light nervine bitters, will be found useful.

T. SHAPTER.

**PRÆCORDIAL PAIN.**—SYNON.: Heartburn; Fr. *Cardialgie*; Ger. *Magenschmerz.*

DEFINITION.—By præcordial pain it is intended in this article to signify pain referred to the region of, but not originating in, the heart.

DESCRIPTION.—Spasmodic, not paroxysmal, præcordial pain may vary from a slight uneasiness to an intense anguish. It may have different characters; it may be sharp and lancinating, dull and heavy, twisting, or grinding. Its seat may be defined, or it may be diffused over a large surface. It is met with mainly in persons of a nervous temperament, in the gouty and dyspeptic, in the course of certain of the blood-diseases, and as an accompaniment of special female disorders. A common seat of this pain is the left fourth intercostal space below, or, rather, outside, the line of the nipples. The patient associates it with the heart; and yet describes it as not so deeply seated, nor in any respect influenced by its action—having no rhythmical exacerbations; generally it is confined to this spot, but may be diffused over the chest. A severe form of this pain, though for the most part confined to the region of the heart, often extends from the præcordium to the left shoulder, the neck, and the stomach; sometimes, though rarely, to the arms. These several forms of pain have analogies with each other, their differences being mainly in seat, in intensity, and in their complications with other disorders; they are irregularly remittent; they do not partake of the nature of cramp, or spasmodic constriction; and apparently they have little or no influence on the heart's action, or on that of the respiratory organs. For the most part, though their manifestation may be severe, and therefore alarming to the patient, they do not, simply and unassociated, indicate the presence of disease of a fatal tendency. They are to be esteemed as capable of alleviation, and generally of cure. If there be danger, it is chiefly due to complications with organic disease of the heart, or other contiguous organs; they partake of the nature, and obey the laws, indications, and phenomena, of ordinary nerve-pains, such as tic-douloureux, or those of sciatica or lumbago; and they have their seat primarily in the pneumogastric or cardiac nerves, and, secondarily, in the nerves of the brachial plexus, and the cerebro-spinal nerves supplying the front of the thorax.

PROGNOSIS AND TREATMENT.—The prognosis and the treatment of these affections require that their origin, seat, intensity, persistency, and complications should be well considered; each being a measure of disorder, and a guide to the means of alleviation.

The severe paroxysmal or recurrent pain, which appears to have its seat mainly in the branches of the vagus nerve, is essentially of dyspeptic origin, and requires, with well-regulated diet and exercise, very careful medical management. The indications for the most part are to correct an acid or gouty diathesis. Alkalies, and the alkaline mineral waters, light bitter infusions, and warm alterative aperients, are often most useful in these cases. The intercostal pain is somewhat persistent and difficult of alleviation and requires, besides attention to the morbid states with which it may be associated —the hysterical and dyspeptic, the plethoric and hypochondriacal, the emaciation and weakness

of exhausting diseases, a strictly regulated diet, with exercise and residence in a pure air. The pains originating in disordered conditions of the blood usually find relief in the regimen and treatment laid down for their alleviation.

T. Shapter.

**PRÆSYSTOLIC.**—A term implying antecedence to the ventricular systole, and used in connexion with a cardiac murmur or thrill occurring during this time of the cardiac revolution. *See* Heart, Valves of, Diseases of; and Physical Examination.

**PREDISPOSITION TO DISEASE.**—Definition.—That state of the body which renders it peculiarly liable to be affected injuriously by a morbific agent; determining in the case of a 'non-specific' agent the particular disease which it shall induce in each of several individuals similarly exposed to it; whilst, in the case of a 'specific' agent or 'morbid-poison,' it determines the relative liability of several individuals similarly exposed to it, to become the subjects of the particular disease it is capable of originating, and also influences the severity of its attack.

Thus, of several persons equally exposed to severe cold, which, by chilling the general surface, produces contraction of the cutaneous capillaries and consequent internal congestion, some shall not suffer seriously in any way; but one shall be attacked by bronchitis, another by pneumonia, another by apoplexy, another by gastro-intestinal disturbance, another by jaundice, another by nephritis, another by gout, and so on, according to the part of the body which the congestion most affects in each individual.

Again, of several individuals equally exposed to the poison of cholera, some shall escape altogether, whilst others shall be attacked by choleraic disease: and of the latter, some may suffer only from diarrhœa; in others nothing more may be induced than vomiting, cramps, and rice-water evacuations; whilst in others the disease may develop itself in its full intensity, and rapidly proceed to a fatal termination.

Predisposition may be either *congenital* or *acquired*; and in the former case—unless induced by malformation, or by causes acting through the maternal system during pregnancy, it is usually *hereditary*.

*Hereditary predisposition to disease* seems to follow the same modified laws of heredity as the transmission of *family* peculiarities. These do not imply the same duration or universality in the action of the causes which have evolved them as do the characters of species and race; and consequently, whilst tending to perpetuation if the parentage on both sides be limited to such as participate in them, they tend to die out by free interbreeding. Still, we often see a family feature, or some other physical or mental peculiarity, 'cropping-up' after a dormancy of several generations; thus clearly evidencing the transmission of a potency, which manifests itself whenever some deficient condition has been supplied. So there are certain constitutional states or *diatheses*, which particular abnormal habits of life tend to induce, when their operation continues with cumulative force through successive generations. These, when fully established, so penetrate the entire organism, that perhaps no one process goes on exactly as it would in perfect health. And, when they have once firmly rooted themselves in it, they tend to propagate themselves hereditarily like family characters, even when the original factors have ceased to act, but still more when they continue in operation. Of this we have a conspicuous instance in the hereditary transmission of goître, and its gradual aggravation into cretinism, among the inhabitants of those Alpine valleys in which a close stagnant atmosphere, privation of sunlight, bad ventilation of dwellings, filthy personal habits, and some other local conditions not yet understood, have concurred, through a long succession of generations, to engender the constitutional state which expresses itself in these forms of disease.

So, the fullest evolution of the gouty, the scrofulous, or the cancerous diathesis may require the continued action of their factors for several successive generations; it may be interfered with by the introduction of normal factors by intermarriage; and during its progress the manifestation of these diatheses may be so trivial as to attract but little notice. But when either of them has been fully established by the sufficiently prolonged action of its causes, its hereditary transmission, like that of family peculiarities, becomes the rule rather than the exception, save in so far as it is modified by interbreeding. And even where it seems to have died out, never showing itself in the spontaneous production of any of its characteristic forms of disease, it shall modify the course of almost any other malady, or complicate the results of some accidental injury. Where both parents are the subjects of the same well-marked diathesis, the transmission of it to the offspring is almost a certainty; and the manifestation of it is likely to be yet more marked, if the parents inherit also the same *family* idiosyncrasies.[1]

Although the predisposition to *insanity* is often undoubtedly hereditary, it does not seem to partake of the constitutional nature of a diathesis, except where it depends on the existence of one of the definite forms of mal-nutrition already specified. The fact seems to be that the nervous system is so peculiarly liable to be shaped and modified by the mode in which it is habitually called into exercise, that it takes-on a particular *abnormal* form of activity far more readily than any other organ; and thus, when a special form of malnutrition has once established itself, this may be transmitted to the offspring without the prolonged action of its special factor through many successive generations. We see this particularly in the effect of habitual alcoholic excess, which not only produces a tendency to insanity in the subject of it, but also engenders in the offspring (especially when *both* parents are drunkards) a disordered state of brain-nutrition, which may express itself in

[1] The worst case of this kind that the writer ever saw or heard of, was where the parents were first cousins,—children of two brothers who were both gouty, and who belonged to a family noted for the strong personal and mental resemblance of its members.

idiocy, epilepsy, alcoholic craving, mental instability, weakness of will, uncontrollable hysteria and the like, as well as in insanity. And the same may be said of abnormal moral habits, which, when they have fixed themselves in the cerebral organism, tend to reproduce themselves in succeeding generations; as we see in hereditary kleptomania.

But of all these acquired forms of disordered *neurosis* it may be said that, as it is the peculiarity of the nervous system rapidly to grow to the mode in which it is habitually exercised, so there is less tendency to the hereditary perpetuation of such disorder than where it depends upon an established diathesis, provided that the right methods of physical and moral invigoration are employed for the restoration of the brain's normal activity.

Although it can scarcely be doubted that various other acquired predispositions tend to reproduce themselves in the offspring, there are none which do so with any approach to the constancy and definiteness which are exhibited by those which have become 'constitutional'; and they may, therefore, be dismissed without special notice.

Among the diseases produced by the action of specific poisons, there are some to which the hereditary predisposition must be said to be *universal*; the cases in which these poisons are imbibed for the first time without producing their characteristic effects, being quite exceptional. In this category are to be ranked the exanthemata, and probably syphilis. Dismissing the latter as limited in its propagation by the speciality of its mode of transmission, we recognise the universality of the predisposition to the former in the extraordinary manner in which any exanthem introduced into a community, whose isolation had prevented its invasion for a long previous interval, spreads through a whole population.[1]

But the original liability to any of the exanthemata appears, as a rule, to be extinguished by one attack of it; the cases being exceptional in which the poison develops itself a second time in the body of anyone who has once *fully* exhibited its characteristic effects. And the liability is greatly diminished, and the severity of the second attack usually much mitigated, even when the first action has been incomplete —as is often seen in epidemics of measles and scarlatina. This seems the *rationale* of the 'protection' afforded by vaccination against small-pox; there being (in the writer's opinion) no reasonable doubt that the vaccine virus is nothing else than small-pox poison modified by transmission through the cow, and that the protective influence of vaccinia is thus of the same *kind* as that exerted by a first attack of variola, though perhaps rather lower (unless re-vaccination has been practised) in *degree*.

Much light has recently been thrown on this subject by parallel researches in epizoötic diseases; for it has been found that the poisons of 'Splenic Fever' and 'Fowl-cholera' can be modified in like manner by 'cultivation'; and that the inoculation of these modified poisons produces in the subjects of it very mild forms of those diseases, which serve as a protection against their malignant attacks. And it may now be laid down with tolerable certainty, (1) that the blood of an individual who has been the subject of any of those specific diseases which usually occur only once in life, is so altered (whether by addition or subtraction), that it is no longer liable to be acted on by the same poison; and (2) that this alteration may be produced, and 'protection' imparted to the subject of it, by even a greatly mitigated form of the disease, such as may be induced by the introduction of an artificially modified poison. It may not, Professor Lister thinks, be too sanguine an anticipation, that means may ere long be found for so tempering the poisons of measles and scarlatina, as to make an innocuous 'vaccination' afford a similar protection against their worst effects.[2]

*Acquired Predisposition.*—Any habitual infraction of the laws of health will induce a *general* liability to disease, by producing a depressed condition of the vital activity, whereby the organism is rendered less capable of resisting the influence of morbific agents. But this infraction may be of a kind which induces a liability to some particular disease; as when the habit of rapidly eating a large meal tends to injure the digestive power; or the habit of living in over-heated rooms predisposes to bronchial and pulmonary attacks.[3]

It is, however, in determining the invasion and epidemic spread of diseases that depend upon the *zymosis* set up in the blood by the introduction of certain specific poisons, that the effect of 'acquired predisposition' is most distinctly seen, and can be most definitely expressed. During the severest visitation of cholera or diphtheria, for example, the number attacked is really small in comparison with the entire population; and while, of those who escape, the great mass may be assumed not to have been exposed to the action of the poison at all, yet it is unquestionable that a large proportion of those

[1] Thus, in 1846, the poison of measles having been conveyed to the Faroe Islands, where it had been unknown for sixty-five years, the disease rapidly spread among their inhabitants, affecting old and young alike; more than 6,000 persons out of a total of 7,782 were attacked by it in the course of six months; and scarcely any escaped, save the few aged persons who had been affected when young in the previous epidemic, and the inhabitants of one of the smaller islands, who kept up a rigid quarantine. The Icelandic records (which have been well kept for many centuries) show a similar prevalence of any exanthem that has been introduced after a long interval. Thus in 1707, out of a total population of about 65,000, no fewer than 16,000 (or nearly one-fourth) *died* in an epidemic of small-pox; so that it can scarcely be doubted that, as in the previous case, almost every individual exposed to the poison must have been *attacked* by the disease, unless he had previously been the subject of it. Thirty-four years had elapsed since the disease had been last known in the island; and many persons who had had it before, took it a second time

[2] See his address 'On the Relation of Micro-organisms to Disease,' in *Quarterly Journal of Microscopic Science*, April, 1881.

[3] The writer was informed by Mr. Gulliver, when surgeon in the Life Guards, that the young powerful men of his regiment, mostly sons of Yorkshire farmers, suffered greatly from bronchitis and pneumonia; in consequence, he believed, of their liability to become chilled on going out into cold air, after being shut up for many hours a day in stables unduly heated for the purpose of imparting sleekness to the coats of the horses; the animals themselves suffering in like manner.

who are as fully exposed as those attacked by the disease, do not become the subjects of it. A medical practitioner, again, may unconsciously carry about with him a septicæmic *contagium*, which is innocuous, not only to himself, but to a large proportion of the persons with whom he comes into contact; and yet it may take fatal effect upon certain individuals, who, nevertheless, have received no stronger a dose of the poison than the rest. Further, it is not unfrequently seen that the practitioner or nurse who long seems completely 'proof' against any attack of the epidemic malady to which he (or she) is ministering, at last succumbs to it. It is clear, in these and similar cases, that there must be some 'predisposing condition' not supplied by the *normal* human body, which determines the zymotic action of the *materies morbi* in the individuals who manifest its effects.

Such 'predispositions' have been recognised and specified by all who, at various times, have scientifically studied the ætiology of epidemics; and it has been universally noted that unwholesome food, bad water, and foul air have exerted a singular potency in favouring the action of the poison on individuals and communities. The advocates of the 'germ-theory' and of the 'chemical theory' of zymotic poisons are at one in regard to this fact—that the presence of nitrogenous matter in a decomposing or readily-decomposable state, affords the best possible *pabulum*, either for the development of bacillar organisms, or for the action of ferments. And, building on this foundation, the writer long since [1] came to the conclusion, that the common condition which *all* those agencies tend to produce, which experience has shown to be specially favourable to the development of zymotic disease, is this:—the presence, in the blood of the individual attacked, of an *excess* of those decomposing effete matters, with which the circulating current is normally charged to a limited amount, during their passage from the parts of the body in which they are poured into it, to the excretory organs by which they are eliminated and cast forth. If the amount of these matters be limited to that which is being continually generated in the ordinary 'waste' of the body, and if the great emunctories (the lungs, the liver, the intestinal glandulæ, the kidneys, and the skin) all do their proper work, the products of that 'waste' are drawn-off from the blood-current as fast as they are poured into it, so that the stream is kept pure. But if, on the one hand, such decomposing matters be either abnormally introduced from without, or be generated in abnormal amount within the body; or if, on the other hand, the normal process of elimination be in any way obstructed; or if, still more, an abnormal excess of the one process concurs with deficient activity of the other, a rapid accumulation of these matters takes place in the blood; and this, by providing the *pabulum* requisite for the development of the poison, supplies the very condition necessary for its morbific activity.

Of the effectiveness of the *introduction* of putrescent organic matter, either in food, water, or air, the cholera epidemic of 1848–9 afforded instances so 'glaring' that they here need only to be adverted to.

Of the even more marked potency of the *excessive generation of effete matter within the body*, we have a typical example in the extraordinary proclivity of the *puerperal female* to suffer from the action of any septic poison to which she may be exposed.[2] Nothing can be plainer to the physiologist, than that the return of the uterus, after parturition, to its non-pregnant condition, involves a rapid 'waste' of its muscular substance, the products of which will be poured into the blood-current far more rapidly than they can be eliminated; this state continuing until the process is completed. The like condition exists in subjects of *severe injuries*, and of *operations*; and not only do these exhibit a special proclivity to the action of specific poisons like scarlatina (the disease only then declaring itself, although its germs must have been previously received and lain dormant),[3] but they show a peculiar liability to suffer from the ordinary septic poisons which have no effect upon the healthy carriers of them, erysipelas and adynamic 'surgical fever' being thus communicable.[4]

*Excessive exertion*, again, whether bodily or mental (such excess being marked by the feeling of *fatigue*) has always ranked among the most potent of predisposing causes; and its action is clearly traceable to the same source, the abnormally rapid 'waste' of the tissues, whereby the blood-current becomes unduly charged with the products of their disintegration.[5]

Ample evidence is afforded by army experience, of the special liability of soldiers to zymotic disease, when on long and fatiguing marches; and this especially in hot climates, where, the activity of the respiratory process being reduced by the high external temperature, the products of the 'waste' tend to accumulate in the blood-current.

Of the predisposition induced by the accumulation of effete matter consequent upon *obstructed elimination*, none is more marked than that which results from *overcrowding*. The effect of defective air-supply is not only to reduce the quantity of carbonic acid got rid of by expiration,

[1] See his Paper on 'The Predisposing Causes of Epidemics,' in the *Brit. and For. Med. Chir. Review*, vol. xi., 1853, p. 159.

[2] This proclivity was never more strikingly displayed than in the former experience of the Vienna Lying-in Hospital; where a comparison of the mortality in the two sides of the institution, one attended by midwives, and the other by medical students, showed that an annual average of from 400 to 500 deaths out of 3,000 deliveries was distinctly traceable to the unclean habits of the latter, who were accustomed to come into the wards fresh from the dead-house. The enforcement of proper precautions soon lowered this excessive mortality to the standard of the other side.

[3] Sir James Paget, in *British Medical Journal*, 1864, vol. ii. p. 237.

[4] Sir James Simpson in *Edinburgh Monthly Journal*, vols. xi. and xiii.

[5] It is within the experience of everyone, that the *sense* of fatigue bears no constant proportion to the amount of exertion put forth; and that whilst, on the one hand, any obstruction to the eliminating processes (as by bad ventilation of the sleeping apartment) prevents its removal by rest, an unusually severe and prolonged strain may be sustained without its induction, when the excretory apparatus is stimulated to increased activity, as in 'training.' And there is strong reason, therefore, for regarding this feeling as indicative of the degree in which the blood is charged with the products of nervo-muscular 'waste.'

but also (which is probably of yet greater importance in relation to zymotic disease) to diminish the normal oxidation of those nitrogenous effete matters, of which (when thus metamorphosed) it is the special business of the kidneys and skin to get rid. The accumulation of these within the body speedily makes itself manifest in the offensiveness of the *halitus* of the breath (the condensation of which shows the presence of fœtid matter) and of the cutaneous transpiration; and thus, although there may be no introduction of decomposing matter into the body, or specially rapid internal production of it, the blood-current becomes as effectually charged with the *pabulum* of the zymotic poison as if this had been injected into it.[1]

The strong predisposition to zymotic disease induced by *intemperance*, which has been no less conspicuously manifested in the experience of our Indian army, seems clearly traceable to the same source. For the habitual presence of alcohol in the blood-current undoubtedly diminishes the oxidation of the 'waste' products, and thus occasions their accumulation in the system; and this at a greater rate in hot climates than in cold, on account of the already reduced activity of the respiratory process in the former. Where, again, the rate of 'waste' is abnormally increased—as on the march of troops—the evil influence of alcoholic liquors is still more strongly manifested; and this will be again aggravated by overcrowding in tents or barracks.[2]

[1] Thus it has come about, that, while the average mortality of European troops in India under favourable circumstances does not exceed 30 per 1,000, it has been raised at particular stations through a long succession of years—solely by overcrowding in ill-ventilated barracks—to 75 or even 100 in the 1,000; whilst in certain Indian gaols, in which the air-space was actually at one time less than 100 cubic feet per prisoner, the mortality rose to an annual average of *one in four*.

A most remarkable instance of the combined action of the two last-named 'predisposing' causes, resulting in the *double*-charging of the blood with the *pabulum* most suited to the development of zymotic poison, was furnished by the terrible outbreak of cholera, which carried off *one-eighth* of the troops stationed at Kurrachee in 1846; no fewer than 464 deaths having then occurred out of a total strength of 3,746. Some of the troops (*a*) had recently come off a long and fatiguing march, but were well accommodated in airy barracks; and their loss was at the rate of 96·6 per thousand. In another regiment (*b*), which had not been on the march, but was overcrowded in small ill-ventilated tents, the rate was 108·6 per thousand. And in a third (*c*), which had made the march like *a*, and were overcrowded like *b*, the mortality was 218 per thousand, or at a rate actually exceeding *their* high rates added together.

[2] Of this, Dr. Parkes's experience as assistant-surgeon to the 84th Regiment in India, afforded a striking illustration. A large proportion of the men of this regiment were total abstainers, and the remainder were very temperate. During the year 1846-47, it was quartered for eight months in the healthy barracks of Fort St. George, Madras; it then performed a march of between 400 and 500 miles to Secunderabad, in a very wet and unhealthy season, through a country infested with fever and cholera; and the remaining two months were spent in overcrowded barracks at Secunderabad. Yet the mortality during that year was only 13 in an average strength of 1,072, or at the rate of 12·1 per 1,000. Continuing during the next year in the same overcrowded barracks, its loss was raised to 34·9 per 1,000; but this was *less than half* the average mortality of the troops quartered in the same barracks for fifteen years past. The 63rd Regiment, with which they had exchanged, though not specially noted for intemperance, had there lost 73 men in the first nine months of the previous year, or at the annual rate of 78·8 per 1,000; and, having then marched to Madras to take the place of the 84th, had so many sick when the two regiments met on the road, as to be forced to borrow the 84th's dhoolies.

On the connection between *famine* and *pestilence*, it is unnecessary to enlarge; but it affords the key-stone of our cumulative argument. For in whatever way it is to be accounted for, the fact is certain, that a state of general blood-contamination is produced by the accumulation of non-eliminated products of 'waste.' In the Irish famine of 1847, the fœtid secretions from the skin, the rapid supervention of general putrescence after death and its manifestation even previously, and the frequent termination of life by colliquative diarrhœa, all evidence the peculiar fitness of the body so conditioned for the development of a zymotic poison.

And thus we seem furnished with a scientific *rationale* for all that experience has taught as to the conditions of the spread of zymotic disease; which, by giving greater definiteness and consistency to medical doctrine, will afford a surer and more positive basis for preventive *hygiène*, both public and individual.

But whilst it is specially in establishing a predisposition to zymotic disease, and in aggravating the severity of its attacks, that the contamination of the blood-current by the accumulation of 'waste' products most strikingly manifests itself, there can be no doubt that it lowers the healthy vigour of the body generally, and thus renders it more ready to be affected by any disease to which it may be constitutionally liable. Where any form of mal-nutrition exists—whether resulting from imperfect performance of the primary digestive processes, producing ill-made blood, or from imperfect conversion of blood into tissue—there must be premature degeneration and augmented 'waste'; and the rate of this augmentation must tend to increase, if special attention be not given to the eliminating processes. Here we have the *rationale* of the fundamental importance of pure fresh air, as cool as it can be borne, to the scrofulous subject; and of the remarkable cures sometimes effected in patients in whose lungs tubercular deposit has already commenced, by the hazardous discipline of a hardy out-door life. When any serious malady has once established itself, the degeneration of tissue, as shown in the rapid wasting of the body, takes place with augmented rapidity; and the necessity for the removal of its products is proportionately urgent. And this is not the less important when the progress of the disease is stayed; for the purification of the blood from the contamination it has received is absolutely essential to the establishment of those recuperative processes on which the final issue depends. Of the due elimination of the waste-products, their oxidation is the first and most fundamentally-important act; and of the direful consequences of past ignorance and neglect of this principle—evinced on a large scale in the overcrowding and bad ventilation of hospitals, poorhouses, and gaols—their records too surely tell. Even now our practice is far from perfect in this particular; and it is scarcely going too far to affirm that, not only the public, but the medical profession, have still much to learn as to the importance of an ample supply of pure

air, both for the prevention and the cure of disease.[1] WILLIAM B. CARPENTER.

**PREGNANCY, Diseases and Disorders of.**—SYNON.: Fr. *Maladies et Troubles de la Grossesse*; Ger. *Krankheiten und Stöhrungen der Schwangerschafts.*

Under this heading are included all those complaints which arise from the pregnant state, or which, occurring during gestation, are so modified, or exercise such an influence over it, as to require special treatment. The subjects of false pregnancy and concealed pregnancy will also be noticed. The principal conditions which demand consideration in this article are therefore the following:—1, vomiting; 2, abortion; 3, ptyalism; 4, retroversion and retroflexion of the uterus; 5, anteversion and anteflexion; 6, embolism; 7, extra-uterine pregnancy; 8, pruritus of the pudendum; 9, œdema of the labia and lower extremities; 10, œdema of the upper extremities; 11, hæmorrhoids; 12, dropsy of the amnion; 13, cramps; 14, eclampsia; 15, false, and 16, concealed pregnancy. *See* FŒTUS, Diseases of.

The foregoing list of the principal diseases of pregnancy might be much extended if, following the example of eminent obstetric authorities, we were to include jaundice, constipation, diarrhœa, cardialgia, headache, insomnia, palpitation and hypertrophy of the heart, rheumatism, inflammation of the uterus, &c. To these and most other diseases pregnant women are liable; but not being in any way peculiar to pregnancy, or essentially modified thereby, they require no notice in this place.

It would also be beyond the scope of this article to refer to all those anomalous sympathetic disturbances of the nervous system, such as longings, morbid or depraved appetite, hysterical irritability, nervous pains, odontalgia, &c., that sometimes attend gestation, and which, unless excessive, may be regarded as symptoms, and not included amongst the diseases of pregnancy.

**1. Vomiting.**—The most common complaint of pregnancy is morning sickness, or nausea and retching, usually confined to the forenoon, and continuing from the third week after conception until the period of quickening.

The sickness of pregnancy is generally attended by no loss of appetite or impairment of health, and may thus be distinguished from vomiting caused by gastric or other diseases.

In some exceptional instances, however, this complaint assumes a graver aspect; continues throughout the whole term of gestation; harasses the patient by continual retching; and, as occurred in one case which came under the notice of the writer, may even cause death from exhaustion.

ÆTIOLOGY.—The ætiology of morning sickness is a subject on which much ingenuity has been wasted. For many years Smellies' theory prevailed. 'Perhaps,' he says, 'this complaint is chiefly occasioned by fulness of the vessels of the uterus . . . . (this) being stretched by the ovum, a tension of that part ensues, affecting the nerves of that viscus, especially those that arise from the sympathetici maximi and communicate with the plexus at the mouth of the stomach.'

Most of the diseases peculiar to women are now ascribed by some authorities to displacements of the uterus, which are regarded by Dr. Grailey Hewitt as 'the almost universal cause of the vomiting of pregnancy.' The same writer—whose views, however, have been controverted by Dr. McClintock, Dr. Tilt, and others—insists that 'it is the compression undergone by the uterine tissues (markedly by the nervous fibres at the seat of the flexion) which is the cause of the nausea and sickness.'

TREATMENT.—The treatment of this complaint depends on the period of pregnancy, the severity of the symptoms, and the constitution of the patient. In ordinary cases it may be prevented by the patient remaining in bed until the usual period for its return has passed over. Her diet should be light, and she should take as little fluid as possible, especially avoiding all warm drinks, such as tea. The bowels should be regulated by mild antacid aperients or effervescing salines. At the same time some of the so-called specifics may be ordered, such as oxalate of cerium in two-grain doses, or hydrocyanic acid, with infusion of calumba. It is unnecessary to refer to all the, generally useless, remedies which have been proposed for this complaint, including the dilatation of the cervix uteri, first suggested by Dubois, and more recently recommended by the late Dr. Copeman, of Norwich; the hypodermic injection of morphia; chloral; carbolic acid; and minute doses of ipecacuanha.

In some cases of excessive vomiting occurring in plethoric patients, six or eight ounces of blood may be taken away with advantage. If, notwithstanding this, the sickness continues, and the patient is in danger of dying from exhaustion, the propriety of inducing premature labour becomes a grave question. In no case should so serious a measure be resorted to without full deliberation and consultation. In all cases it should be deferred as long as possible, and in fixing the period for its performance regard should always be paid to the possible viability of the fœtus.

**2. Abortion.**—The expulsion of the fœtus before the ordinary period of viability may result from diseases affecting either the mother or the ovum. Amongst the former are constitutional syphilis, scrofula, fevers (especially the exanthemata), and general plethora; and, according to Dr. R. Lee, 'all the chronic diseases to which the uterus and its appendages are liable may also be considered causes of abortion.' The ovuline causes are cystic or other placental diseases and

[1] The peculiar susceptibility of the nervous system of children often affords a most striking *test* of atmospheric impurity that might otherwise pass unheeded. In the last century, *trismus nascentium* (a disease now rarely seen) was one of the principal factors of the very high rate of infantile mortality which then prevailed. This disease continued to be very fatal in the Lying-in Hospitals of Dublin, after it had almost disappeared from those of London; and it was mainly by the attention to their ventilation enforced by Dr. Joseph Clarke, that the mortality of the infants born in them was reduced. The disease has continued to our own day, under precisely similar conditions, in St. Kilda, and some parts of Iceland, where *two-thirds* of all the children born have died in the first twelve days. Even in what would be accounted the well-ventilated dwellings of our own middle and higher classes, obstinate cases of spasmodic croup, recurring with the appearance of every tooth, are frequently seen, which immediately yield on the removal of the little patients to the pure air of the country or the seaside.

syphilis. It is unnecessary to discuss such a range of subjects here. *See* MISCARRIAGE.

3. **Ptyalism.**—This is an occasional complaint of early pregnancy, but seldom requires any treatment. In exceptionally severe cases, salivation may be controlled by the application of tannoglycerine and astringent gargles, especially chlorate of potash in infusion of bark; or, where those fail, by the application of a few leeches to the sub-maxillary glands.

4. **Retroversion of the Uterus.**—This form of displacement sometimes occurs in early pregnancy, from pressure of the enlarging womb on the neck of the bladder, which, thus prevented from completely emptying itself, becomes so distended that it gradually forces the fundus uteri downwards and backwards into the hollow of the sacrum, whilst the cervix is tilted upwards and forwards against the symphysis pubis. The symptoms of this occurrence are difficulty in passing water, or even complete retention of urine, with tenesmus and powerless straining to empty the bowels. At the same time a sense of weight, or fulness, and bearing-down pains in the pelvis are complained of.

TREATMENT.—The treatment of retroversion during pregnancy must be prompt, as, if it be complete, it not only occasions considerable suffering to the patient, but also certainly ends in the premature expulsion of the fœtus. In cases of slight retroversion, the displacement may be remedied by emptying the distended bladder with the catheter, supporting the uterus with a Hodges' pessary, and keeping the patient lying on her face for a few days. In complete retroversion this becomes a matter of considerable difficulty. The patient should be placed on her hands and knees; the bladder emptied; and the fundus pushed up from the rectum by a couple of fingers of one hand, whilst with the other hand the cervix is pulled down. A well-bent pessary should be passed up into the posterior *cul-de-sac* of the vagina, and the recumbent position rigidly maintained for some time.

5. **Anteversion and Anteflexion of the Uterus.**—Anteversion and anteflexion of the uterus are very exceptional complaints during pregnancy. The patient complains of bearing-down pelvic pains, and on examination the os uteri will be found in the posterior *cul-de-sac* of the vagina, looking towards the sacrum, the fundus uteri pressing on the neck of the bladder, and occasioning at first incontinence of urine, which, as the displacement increases, changes to difficulty in micturition or complete retention. In anteversion, abortion is said to occur at an earlier period than in retroversion.

TREATMENT.—The treatment consists in placing the patient on her back; mechanically reducing the displacement; and applying a cradle pessary.

6. **Embolism.**—We occasionally, though, fortunately, rarely, meet with cases of sudden death during pregnancy which cannot be accounted for by any cardiac disease, aneurism, or accident. In the pregnant state a strong predisposition to the formation of a fibrinous clot or thrombus exists, and this is increased by any circumstance that depresses the circulation, such, for instance, as the fainting that frequently attends quickening. The thrombus may be carried away and become impacted in the pulmonary artery or elsewhere, at any subsequent period of gestation, blocking the current of the circulation and causing sudden death.

There are no symptoms by which a thrombus can be recognised, until its presence is discovered after death. And the only lesson we can learn from the history of such cases is the necessity of watchfulness during gestation, to prevent the occurrence of any undue depression of the circulation.

7. **Extra-uterine Pregnancy.**—This is a rare condition of morbid gestation, generally the sequence of pelvic inflammation, extending to the Fallopian tubes, and rendering the passage impervious to the fertilized ovum. Hence multiparæ are most liable to it.

Four varieties of extra-uterine pregnancy are described, namely, *ovarian*, *interstitial*, *ventral*, and *tubal*. The latter is most common. The early symptoms of ex-fœtation cannot be distinguished from those of natural pregnancy. But as the patient approaches the fourth month, she begins to complain of something unusual in her condition; and, later on, considerable dull pain and sense of fulness in the pelvis are experienced. On examination the os uteri will be found patulous, the cervix undeveloped, and a semi-solid tumour may be felt in Douglas's space between the vagina and rectum. If, under these circumstances, the sounds of the fœtal heart are heard in an unusual situation, there can be no doubt as to the nature of the case.

In tubal pregnancy the cyst generally ruptures before the third month, and the patient dies undelivered, from shock and hæmorrhage. In exceptional cases, however, the misplaced gestation may go on to the full term, and the fœtus having then perished, after an abortive effort at expulsion, it may be retained for many years without material inconvenience. Extra-uterine pregnancy depends on causes entirely beyond the reach of medical treatment.

8. **Pruritus of the pudendum.**—Pruritus is occasionally a distressing result of the general hyperæsthesia and congestion of the generative organs during pregnancy, and consists in intense irritation, extending over the external orifice of the vagina, labia, and clitoris. The itching occurs in paroxysms which are most troublesome at night, and in aggravated cases wear out the patient, mentally and physically, from the loss of rest and constant irritation. In most cases this may be relieved by bromide of potassium in large doses, and the application of a strong solution of borax or of nitrate of silver, or sedative lotions to the affected parts.

9. **Œdema of the lower extremities.**—Œdema of the lower limbs, from the pressure of the gravid uterus on the veins, is a common complaint in the later months, and seldom requires any treatment beyond rest and aperients. Nor is the dropsical tumefaction of the labia, which occurs from the same cause, more serious.

10. **Œdema of the face and upper extremities.**—This is always an alarming symptom during pregnancy, foretelling uræmic convulsions, and, if attended by albuminuria, urgently demands active treatment, such as depletion by

cupping over the loins, and strong saline purgatives.

In all cases and forms of dropsy during pregnancy, the urine should be daily tested for albumin; and if this be found, the case must be treated as one of impending convulsions.

11. **Hæmorrhoids.**—At all times women are more subject to this complaint than men, and during pregnancy, owing to the pressure of the gravid uterus on the hæmorrhoidal and internal iliac veins, comparatively few escape either internal or external piles. As Smellie observed, 'the same method of cure may be administered as that practised at other times, though greater caution must be used in applying leeches to the parts.'

12. **Dropsy of the Amnion.**—This condition is met with in some cases of abortion from hydatidinous or other placental disease. It also occurs from simple over-secretion of the amniotic fluid, and is then chiefly of interest as the cause of a condition to which the older writers attached great importance, namely, pendulous belly. This was regarded by Devanter as the ordinary source of obliquities of the uterus, and of difficult labour. Without discussing that question, we must regard this condition as of some importance, not only from the inconvenience it occasions, and which can only be palliated by an abdominal belt, but still more from the probability of its leading to *post-partum* hæmorrhage, from inertia of the over-distended uterus. Hence in these cases it is necessary to deviate from the ordinary rule of midwifery practice, by rupturing the membranes, the presentation being natural, as early as possible during labour.

13. **Cramps.**—Cramps in the legs, from uterine pressure on the large nerve-trunks at the brim of the pelvis, are common during the last months of pregnancy, and generally come on at night in the course of the anterior crural nerve, extending down into the calves and feet. In ordinary cases no treatment is required, unless friction over the seat of pain, and some aperient, can be so called. Where, however, as sometimes happens, the cramps become unusually severe and frequent, their recurrence may be prevented by the pressure of a bandage or elastic stocking.

14. **Eclampsia.**—This is, with one exception, the most serious complication of gestation. The true convulsions of pregnancy are *sui generis* in their nature, though they are usually, but erroneously, classified as hysterical, epileptic, or apoplectiform convulsions.

Hysterical convulsions, being nothing more than an attack of hysteria, accidentally affecting a woman in the early months of pregnancy, require no special treatment, nor any further notice.

The so-called epileptiform and apoplectiform convulsions of pregnancy are identical in their character, and are influenced in their symptoms by the constitutional state of the patient and the severity of the attack, rather than by any essential difference in the nature of the disease.

Symptoms.—The premonitory symptoms of convulsions are of considerable importance, as by their timely recognition, and the adoption of suitable treatment, the approaching attack may be often warded off. In the majority of cases, eclampsia is preceded by œdema of the upper extremities, face, and eyelids; pains in the lumbar region; albuminuria; and headache, vertigo, or peculiar irritability of temper.

In asthenic eclampsia, the clonic spasms commence with twitching of the muscles of the eyelids, soon increasing in violence; extend to every part of the body; and recur at irregular intervals. In anæmic patients, throughout the attack, the face may be cool and pale, the eye glistening, and the pupil contracted; but, generally, as the convulsions recur more frequently, the impeded respiration induces symptoms of venous congestion: the face becomes livid; the breathing stertorous; the pulse full and labouring; and thus the disease passes from the first into the second stage, or from the so-called 'epileptiform' into the so-called 'apoplectiform convulsions.

In plethoric women, however, the complaint commonly assumes the apoplectic character from the first, setting in by a violent convulsion, immediately after which the patient falls into a comatose state, the convulsions meanwhile recurring at frequent but irregular intervals. After some time, under favourable circumstances, the convulsions cease, and the patient slowly regains consciousness. But, on the other hand, the coma may become more profound, the pulse more labouring, the respiration more embarrassed, and the extremities colder, until at length 'the last sad scene of all' is closed by a violent and final convulsion.

These convulsions may occur at any time of pregnancy, during labour, and within the puerperal period.

Pathology.—The cause of eclampsia is a subject on which innumerable theories have at different times prevailed. The older British obstetricians regarded congestion of the brain as the general cause of this disease, and hence they relied on blood-letting for its cure. Next prevailed the opinion, founded on the views of Dr. Marshall Hall and Von der Kolk, that these convulsions are reflex actions, excited by uterine irritation acting upon the upper part of the spinal cord and medulla oblongata. Space does not allow of any consideration of these or the many other more recent conjectures on the causation of eclampsia.

At the present time this disease is generally regarded as the result of uræmic blood-poisoning, it having been shown by Braunn, Frerichs, and others, that the convulsions of pregnancy are frequently associated with dropsy, albuminuria, diminished excretion of urea and uric acid, and the consequent retention of these compounds in the system.

That convulsive action may be occasioned by uræmic blood-poisoning is well known in other diseases; and during pregnancy the same effect may be produced by the pressure of the gravid uterus on the renal emulgent veins interfering with the functions of the kidneys.

The influence of mental and moral impressions in causing convulsions has been remarked by all obstetricians. The fact of its being the patient's first pregnancy has also some influence; thus, of eight cases that came under the writer's notice, five were *primiparæ*.

Treatment.—*Preventive.*—In the treatment of the convulsions of pregnancy, whenever any of the premonitory symptoms already described, and more especially albuminuria, are observed, we should direct our efforts to the depuration of the blood, by cupping over the kidneys, and the administration of mild diuretics, saline purgatives, and diaphoretics. At the same time we must endeavour to allay nervous irritability by sedatives, of which in these cases the best is bromide of potassium.

*Immediate.*—During the convulsions precautions to prevent a patient from biting her tongue, or from injuring her person in any way, should in the first instance be taken. One of the most effectual means of shortening the paroxysms is cold affusion on the head and face. In the asthenic form of eclampsia, however, this remedy should be used cautiously. In all cases the bowels should be unloaded by calomel and jalap, or by a drop of croton oil, or by the assafœtida enema; the head should be shaved and blistered, or ice applied, and at the same time sinapisms be put on the legs.

In cases of sthenic convulsions bloodletting is—notwithstanding the disusage into which this has now fallen—the only remedy of undoubted efficacy in subduing the convulsive action. If the patient be plethoric, and her pupils be contracted, we may, as a rule, bleed. If, on the contrary, the pupils be dilated, the condition of the brain may be considered as anæmic, and bloodletting would probably be out of the question.

The amount of blood that may be taken from a plethoric woman suffering from eclampsia should be measured by the patient's condition, and the effect produced, rather than by the quantity abstracted. In hysterical convulsions, if cold affusion does not suffice, the inhalation of chloroform or ether will generally cut short the attack. But in true puerperal convulsions, in which the writer has tried chloroform pretty extensively, it requires to be used with great caution, being contra-indicated whenever the circulation is depressed, or where there is any tendency to apoplectiform symptoms. In suitable cases, however, he has found chloroform serviceable in subduing the convulsions, and prolonging the intervals between them. Chloral was suggested by the writer several years ago. Opium was at one time largely prescribed in these cases; so also was belladonna, originally introduced into practice by M. Claussier upwards of fifty years ago, and again recommended by recent writers. As a substitute for bloodletting, the tincture of veratrum viride is now employed by some American obstetricians. In the actual treatment of convulsions time is too important to be wasted in experimenting with these uncertain drugs; though in the prophylactic treatment of convulsions during pregnancy and after parturition, the writer has found small doses of belladonna beneficial in calming the nervous susceptibility so intimately connected with convulsive action.

In every case of convulsions towards the end of pregnancy, our primary object should be to deliver the patient as speedily as is consistent with her safety and that of her child.

15. **False Pregnancy.**—Synon.: Pseudocyesis.—This is a subject of considerable interest in an obstetric as well as a medico-legal aspect. Spurious pregnancy is of more frequent occurrence than is generally supposed; nor is it confined, as some writers assert, to sterile elderly women of the upper classes, many cases of the kind having come before the writer in hospital and dispensary as well as in private practice.

Ætiology.—With regard to the period of life at which pseudocyesis is most frequent, authorities differ. The writer has known it to occur in a girl of sixteen years of age, but the great majority of cases are met with about the period of 'the turn of life,' or between the ages of forty-five and fifty. The causes of pseudocyesis, besides those before referred to, namely change of life, dyspepsia, and hysteria, are very numerous, including ovarian disease, uterine tumours and physometra, abdominal plethora and obesity, molar pregnancy, and cystic disease of the ovum. Molar pregnancy generally terminates between the third and fourth months; but if continued beyond the latter period, the absence of the positive signs of pregnancy would show the true nature of the case.

Symptoms.—The symptoms of spurious pregnancy are occasionally so close an imitation of those of true gestation as to present great difficulties in their diagnosis. Most of the ordinary signs of pregnancy are simulated with extraordinary exactness in many cases of pseudocyesis. Thus we may have amenorrhœa, followed by irritable stomach; swelling of the mammæ; turgescence of the nipples; and great and rapid enlargement of the abdomen, concurring in a woman who wishes to become pregnant. In cases of pseudocyesis, the last of these symptoms may be traced to an excessive deposit of fat in the omentum, or to tumour; it may be caused by distension of the large intestines by accumulated fæces, or, more commonly, by flatus, constituting what the poor in Ireland graphically describe as 'a windy dropsy;' or it may be due to dropsical effusion into the peritoneal cavity.

If to these symptoms be added, as is generally the case, some derangement of the patient's nervous system, we have the superstructure on which most cases of spurious pregnancy are built. As a rule those who suffer from pseudocyesis either fear or wish to be pregnant, and having as it were coached themselves up on the subject, apply their knowledge to their own fancied symptoms with such a morbid concentration of their thoughts on this topic, that they become monomaniacal on it, and deceive themselves as well as others.

Few cases are more difficult to deal with in practice than those now under consideration, and seldom is the obstetric physician more unpleasantly situated than when called in consultation to a patient who, having persuaded herself and those about her that she is pregnant, has made all the usual preparations for the expected event, and who, deceived by those anomalous periodic pains that sometimes occur in spurious gestation, sends for medical assistance under the impression that she is in labour. Cases of this kind show the necessity for much caution in pronouncing any woman pregnant. If the physician

disregard the caution, and unfortunately fall in with his patient's opinion, without sufficient examination in a case of pseudocyesis, as soon as the true state of the case becomes obvious, he will probably be made the scapegoat for the mistake, and suffer all the odium of which a woman's wounded pride is capable.

Diagnosis.—The diagnosis of spurious pregnancy is always a matter of much difficulty during the first months of the disorder. But, however closely the early symptoms of pregnancy may be simulated, the positive signs of pregnancy after the fifth month cannot be counterfeited. And, even from the very first, in spurious pregnancy, it may generally be ascertained, on careful enquiry, that there is something unusual in the symptoms—either some essential one is wanting, or else the symptoms which belong to one period of pregnancy manifest themselves at another, and commonly earlier, time than is natural.

The value of auscultation as a means of diagnosis in these cases is doubtful. Even in the last month of gestation, the fact of the sounds of the fœtal heart and placental *souffle* not being distinguished on auscultation, is no proof that the uterus may not contain a living child. Nor is the value of the positive evidence, derived from the sounds of the fœtal heart and placental *souffle*, as great as it is sometimes supposed to be. An experienced auscultator can with certainty pronounce on the existence of a living child *in utero* from the auscultatory signs present. But all medical practitioners are not experts in this special subject; and we have seen sufficient proof that, by those who form a diagnosis, in such cases, from the presence or absence of any one sign of pregnancy, opinions are sometimes pronounced in haste, which have to be repented at leisure.

A careful examination of the abdomen with both hands, will enable us to ascertain if there be any uterine enlargement, although not to distinguish between the enlargement caused by disease, and that occasioned by pregnancy. To do this, we must institute a vaginal exploration, to determine whether the conditions of the os and cervix uteri be what are usual at the corresponding period of pregnancy.

In cases of pseudocyesis where the patient, being anxious to be thought pregnant, contributes to the deception by making her abdominal muscles so tense and rigid that it becomes impossible to ascertain the size and position of the uterus, we may readily dissipate the phantom tumour, and overcome the action of the muscles, by the use of chloroform. If the abdominal or uterine enlargement be occasioned by flatus or by physometra, percussion over the tumour will afford an easy test.

Treatment.—It is needless to add anything about the treatment of the cases we have been considering. Pseudocyesis is only an effect of certain morbid conditions, the recognition of which we have endeavoured to point out. The treatment of these causes will be found fully described in the articles on these several subjects.

16. **Concealed Pregnancy.**—Concealed pregnancy is a subject so closely allied to pseudocyesis, that a few words on it appear a suitable sequence to the foregoing observations. Of late years the concealment of pregnancy has become more common than was formerly the case. This is mainly attributable to the cheap and vicious literature which circulates so largely amongst the generally badly reared, and oftentimes sorely tempted, victims of seduction in our large cities, whose minds are thus familiarised with crimes of foreign origin, by which too often they seek what they falsely think a safe mode of escaping the penalty of their error. Hence it becomes essential for every medical practitioner to be prepared to meet cases of concealed pregnancy and attempted abortion under various disguises, and thus be enabled to detect and frustrate such crimes. So often has the writer detected pregnancy in patients who applied for emmenagogues under the pretext of simple amenorrhœa, that he makes it a rule—especially in hospital practice, where the class of persons above referred to are more likely to be met with—not to administer any medicine of this kind until he has satisfied himself as to the true state of the case, though this should be done without any expression of a doubt that might be unfounded.

Thomas More Madden.

**PREMONITORY** (*pre*, before; and *moneo*, I warn).—This word is associated with symptoms which give an indication or warning of the advent or onset of certain diseases or seizures; for instance, rigors, during the invasion of fever, and the various auræ preceding an epileptic fit.

**PRESBYOPIA** (πρέσβυς, an old man, and ὤψ, the eye).—Impairment of the power of accommodation of the eye, the result of progressive senile changes, in consequence of which the nearest point of distinct vision lies at more than nine inches from the eye. Distant vision may be perfect; but the eye, unaided by an appropriate convex lens, cannot see clearly objects less than nine or more inches from the eye. *See* Vision, Disorders of.

**PRESSURE.**—This is an important subject from several points of view, but it will only be practicable in the present article to discuss it generally, without entering into details, and to offer suggestions for further consideration.

1. **Ætiology of Pressure.**—As one factor in the causation of various morbid conditions, pressure is not uncommonly of much consequence, and it may itself originate certain lesions.

The pressure often comes from without, of which the following illustrations afford sufficient examples. General pressure upon the chest and abdomen preventing the movements of breathing, may lead to death from suffocation, to fractured ribs, or to other consequences. This sometimes happens, for instance, when a person is crushed in a crowd, or is buried in a fall of earth, although the head may be free. Hanging and strangulation are forms of violent pressure exercised on the windpipe and vessels in the neck. The pressure of clothing is often very injurious in connection with the chest, especially that produced by tight stays. This leads to contraction or distortion of the chest; interference with the functions of the lungs, heart, stomach, and other

organs; displacement of organs; or actual pulmonary disease. A familiar illustration of the effects of pressure is found in the development of corns and deformities of the feet, from wearing tight boots; and in the distortions of the feet artificially produced in Chinese women by means of systematic pressure applied in early life. In this connection may also be mentioned the wearing of tight garters, or other forms of local constriction, which especially tend to interfere with the passage of the blood through the veins, and to develop varicose veins. Occupation may be the cause of pressure originating disease. Thus, prolonged sitting at various occupations has been supposed to set up sciatica. Direct compression upon any part of the body, by implements used in certain callings, may originate morbid conditions. For instance, pressure thus induced upon the sternum is liable to cause deformity of the chest; and when exercised upon the epigastrium, it has been supposed to account for the local development of cancer of the stomach. Lastly, prolonged pressure from lying in one position for a length of time not uncommonly causes localised inflammation, gangrene, and bed-sores, in persons suffering from low fevers, paralysis, emaciation, and other conditions. *See* Ulcer.

Pressure is often exerted by morbid conditions in the body itself, affecting other structures in the neighbourhood, and thus inducing secondarily various symptoms, pathological phenomena, or actual diseases. It may be more or less diffused, as in the case of an effusion of fluid into a serous cavity; or concentrated upon a certain limited region or individual structure, as often happens with aneurisms and solid tumours. In this way movements may be interfered with, or more obvious effects may be produced, namely, displacement of organs and structures; compression of tubes, canals, hollow organs, or vessels, which may lead to their complete closure; irritation and inflammation, which may end in suppuration or gangrene; or actual destruction. The phenomena induced will depend upon the seat of the cause of pressure, and the structure which it affects.

2. **Pressure in Diagnosis.**—Patients may be conscious of a local subjective feeling of pressure, which in some instances may be of a certain value in diagnosis; but such sensations must never be regarded as reliable. The objective effects of pressure are, however, often evident, and afford clinical signs of the greatest diagnostic value, as is frequently illustrated in cases of diseases of the chest and abdomen. Moreover, the practitioner can, by means of pressure with the fingers or hand, himself determine many points of essential value in the investigation of numerous cases. Indeed, pressure is often an important part of palpation or manipulation, as employed in physical examination (*see* Physical Examination), and is especially useful in the following particulars:—By this means we are able to determine the existence and degree of local tenderness or hyperæsthesia. Pressure also helps to reveal the presence of air or fluid in the subcutaneous cellular tissue. It is absolutely necessary for bringing out the feeling of fluctuation, degree of resistance, tension, and other sensations; while the effect of pressure in modifying certain physical conditions may be of great service in diagnosis, as may be exemplified by the influence thus produced in many cases upon an accumulation of fæces in the intestines. Pressure upon arteries or veins is employed with the view of observing its effects upon the local circulation, arteries, tumours and other morbid conditions; and, in the case of the arteries, to determine the compressibility of the pulse.

3. **Pressure in Treatment.**—In this connection the first point to be noticed is the necessity of removing or avoiding any source of external pressure which is causing mischief; and also of getting rid of internal pressure, if this is practicable. Pressure may frequently be employed with advantage as a therapeutic agent. It may be thus used in a more or less diffused manner; or concentrated on a limited surface. It may be practised by the fingers or hand; by means of plasters, bandages, elastic apparatus, and similar appliances, sometimes of an elaborate kind; or by special surgical apparatus or appliances, such as the tourniquet, acupressure, the ligature, the clamp, or trusses of different forms. Pressure also constitutes one element in friction and shampooing.

As regards the objects for which pressure is employed, in the first place, it not uncommonly helps to relieve pain, which may be illustrated by the effects of manual pressure in subduing the pain of intestinal colic; the relief often afforded to certain forms of headache by applying a bandage or handkerchief tightly round the head; and the beneficial results following the fixing of more or less of one side of the chest, by means of strapping or other agents, in cases of pleurisy or pleurodynia. Local pressure may also cure certain forms of neuralgia. Again, direct compression is sometimes employed to check symptoms produced by reflex influence; thus pressure over the ovary may check vomiting, spasmodic or convulsive movements, and other phenomena connected with hysteria. Another use of pressure is to arrest the process of inflammation, which is exemplified by the practice of strapping the testicle in the early stage of orchitis. In relation to this point, a very important object for which it is employed is to promote the absorption of morbid accumulations and products of all kinds, whether originating from inflammation or other causes. Thus it helps to get rid of air; of fluid effusions, inflammatory or dropsical; of fibrinous exudations; and of thickenings or indurations remaining after acute inflammation, or resulting from chronic inflammatory process. Pressure is again frequently taken advantage of for its influence upon the blood-vessels. Thus it checks different forms of hæmorrhage, the kind of compression required varying with the precise form of bleeding. Elastic pressure, according to Esmarch's method, has been found of great service in preventing bleeding during operations. In connection with arteries direct compression is also often employed for the cure of aneurisms. As regards the veins, pressure is of essential service in preventing the injurious consequences likely to result from varicose dilatation of these vessels, and in giving them support; while it is also made use of in the cure of this condition, especially in connection with

certain operative procedures. In the case of the abdomen, pressure is often of much service to counteract the ill-effects of relaxed and flabby walls. It may also be used to excite contraction in the intestines, bladder, or uterus, under certain circumstances; and to aid in the removal of accumulations in the bowels. Lastly, pressure is made use of in preventing certain forms of displacement of organs and structures; and in attempting to cure the conditions upon which they depend, as is exemplified by the application of a truss in cases of hernia, and by some of the operations for the radical cure of this complaint. FREDERICK T. ROBERTS.

**PREVENTION OF DISEASE.** *See* PERSONAL HEALTH; and PUBLIC HEALTH.

**PRIAPISM.**—SYNON.: Fr. *Priapisme*; Ger. *Priapismus*; *Ruthenkrampf*.

DEFINITION.—A term generally understood to signify unduly occurring or unnaturally prolonged erection of the penis, accompanied or not, as the case may be, by inordinate sexual desire.

It is important to distinguish between mere turgescence of the organ—*false* priapism; and *true* priapism, or perfect erection. The former depends simply upon distension by blood, induced or permitted by relaxation of the walls of the blood-vessels and blood-spaces; it may be associated with comparative flaccidity, and, though uncomfortable, is rarely painful. The latter requires for its production, not only distension by blood, but a certain kind and degree of tension or contraction of the intrinsic muscular fibres of the trabeculæ and sheaths; it is characterised by manifest rigidity, and if long continued—as it may be for several days or even longer—may give rise to considerable suffering.

DESCRIPTION.—Priapism, more or less pronounced, from time to time occurs in connection with various morbid affections of the general system, or of particular organs. Thus it usually, though not invariably, attends erotic mental derangement. It occurs frequently in tetanus and hydrophobia, and sometimes, occasionally even to a distressing extent, during recovery from the eruptive fevers. It has been noted in some cases of tumour or other disease of the cerebellum and pons varolii; and in the earlier stages, or among the first indications, of certain diseases of the spinal cord, leading on to paraplegia. An overloaded condition of the lower bowel, especially in conjunction with enlarged and irritable prostate, inflamed hæmorrhoids, distension of the bladder, stone in the bladder, phimosis, urethritis, and other conditions, may be enumerated as not infrequent local causes of troublesome, though transient, priapism, acting either by pressure on the blood-vessels, or by reflex nervous influence. It also occurs among the results of injuries of the central nervous system, as well as of the penis itself. Injuries of the spinal cord, especially in the cervical and lumbar regions, are liable to be followed by continued or recurrent priapism, or by turgescence with flaccidity. Sudden erection, with emission, not infrequently attends injury of the cervical spine. Numerous cases are on record in which, during violent coitus, or otherwise during erection, the penis itself has undergone injury; and some portions or other of the sheaths of the corpora cavernosa, with the included blood-vessels, have been ruptured, or some blood-vessel has been ruptured, the sheaths remaining entire. In such cases extravasation of blood, followed by turgescence of the corpora cavernosa, occurs; and sooner or later the most persistent, and very often painful, priapism ensues.

TREATMENT.—The treatment generally must depend upon the due recognition and treatment of the condition on which the priapism depends. If of central origin, it is to this point that attention must be directed. But it not infrequently happens that the local suffering is so considerable as to demand special measures for its relief. In some cases cold applications, in others warm or hot fomentations with anodynes, have proved most efficacious. Leeching has rarely been useful. Bandaging, masturbation, and sexual congress have often been tried; but the result, as a rule, has been to increase rather than to mitigate the evil. In cases in which extravasation of blood following injury is the cause, it may be necessary to make incisions, turn out any clots, and arrest further hæmorrhage; but permanent damage to the organ usually results, sometimes after prolonged suppuration, and sometimes even after risk to life.

Among the medicines that have seemed more or less useful in various cases may be especially mentioned bromide of potassium, lupuline, camphor, hyoscyamus, and belladonna. Free purgation is beneficial in some cases.

ARTHUR E. DURHAM.

**PRICKLY HEAT.**—An eruption of minute pimples, which cover the skin more or less extensively, and are attended with burning heat, and a most tormenting prickly itching. The affection occurs for the most part in hot climates, and attacks principally those who are unaccustomed to extreme heat; hence it is often experienced by travellers in tropical regions. Pathologically it is a lichen, attended with great irritability of the skin, and from its dependence on heat of climate, has received the designation of *lichen tropicus*. This disorder will be found described under the head of LICHEN.

**PRIMARY** (*primus*, the first).—This word is either used to imply that a disease originates in an organ or structure from a local cause, such as *primary pleurisy* or *peritonitis*, or *primary attacks*; or it is associated with the first manifestation of a disease, such as the *primary sore* of syphilis, or *primary cancer*. It is also applied to the *direct* or *immediate* symptoms of a disease, as distinguished from those which may be produced *secondarily* or *remotely*.

**PROCIDENTIA** (*pro*, downwards, and *cado*, I fall).—A falling down of certain organs or structures from their natural position, as of the uterus, rectum, or iris. *See* PROLAPSUS.

**PROCTITIS** (πρωκτός, the anus).—Inflammation of the anus or rectum. *See* PERIPROCTITIS; and RECTUM, Diseases of.

**PRODROMATA** (πρό, before, and δρόμος, a course).—A synonym for premonitory symptoms. *See* PREMONITORY.

**PROGNOSIS.** *See* Disease, Prognosis of.

**PROGRESSIVE MUSCULAR ATROPHY.**—Synon.: *Paralysis atrophica*; Cruveilhier's Atrophy; Wasting Palsy; Fr. *Atrophie musculaire graisseuse progressive* (Duchenne); Ger. *Muskelatrophie; Muskellähmung.*

Definition.—A chronic wasting and alteration in the structure of the muscular tissue, which may consist of (1) simple atrophy; (2) atrophy with granular degeneration; (3) atrophy with fatty degeneration; and (4) atrophy with (the so-called) waxy degeneration.

Ætiology. — Progressive muscular atrophy mostly prevails among middle-aged persons and young adults, and the male sex is more liable to suffer than the female—in the proportion of about six to one. Consanguinity, or hereditary influence, is a powerful predisposing cause, and in the greater number of hereditary cases the atrophy becomes generalised.

The principal exciting causes are excessive muscular exertion; severe cold and wet—particularly when combined; and diseases or injuries of the spine. When the disease follows cold and wet, the atrophy is commonly preceded or accompanied by neuralgic or supposed rheumatic pains, either in the muscles or in the course of their nerves. The disease is also not uncommonly a consequence of syphilis. In those cases that seem to be hereditary there often appears to be no other assignable cause.

Pathology. — Progressive muscular atrophy does not originate, as was formerly believed, in the muscles themselves, but, as the writer has shown, from functional or structural alterations in the nervous centres and their nerves. In fatal cases these alterations are of various kinds. They consist of atrophy of the nerve-cells and their processes in the anterior cornua of the spinal cord, commencing in pigmentary degeneration, and ending frequently in their total disappearance. The blood-vessels are frequently dilated, sometimes to an enormous degree, and around them are generally found areas of granular or fluid disintegration, of greater or less extent, and mixed with exudations, or compound granular corpuscles. Frequently there is an abundance of corpora amylacea. These morbid changes occur in both the grey and white substance. Sometimes one and sometimes both of the anterior horns are reduced in bulk. The anterior nerve-roots are not unfrequently wasted to a greater or less extent, as Cruveilhier originally noticed. In some instances nothing remains of them but the neurilemma; in others the fibres are in process of partial disintegration.

Anatomical Characters.—The affected muscles suffer differently in their degrees of wasting, and present a variety of aspects. In the same muscle, bundles in different stages of atrophy may be seen by the side of others that are unaffected. If the wasting be extreme in all the bundles, a long muscle presents the appearance of a mere fibrous cord or tendon, and a flat muscle may be reduced in a similar way to a kind of membrane. The atrophy may consist of only *simple* wasting, without any granular or fatty degeneration; but in the majority of cases it is accompanied by both these alterations of structure to a greater or less extent, and by variable changes in colour. The muscle is paler than natural, and sometimes quite colourless, or may have a faint yellow tint. Its consistence, in consequence of the increase of interfibrillar connective tissue, is greater than normal. Under the microscope the transverse and longitudinal striæ are found to have disappeared to a variable extent and degree, or are even completely lost; while the sarcous or muscular tissue is transformed into granules, which are sometimes so fine that they cannot be distinguished as separate particles. These granules are soluble in acetic acid.

*Granular* degeneration or disintegration of the muscular tissue may be the only structural alteration, but it is often accompanied or followed by *fatty* degeneration. This latter change, however, may make its appearance at once.

In addition to this transformation of muscular tissue into fatty particles, fat-cells in great numbers are found between the fibres, sometimes in groups and sometimes in linear succession. These may increase in proportion as the muscular tissue is wasted, so that there may be no actual loss of volume in the limb.

*The waxy* or *vitreous degeneration* appears to be confined to the voluntary muscles, and never affects all the bundles of a muscle. It consists of a peculiar transformation of the tissue into a colourless, glistening, and homogeneous substance, in which the transverse and longitudinal striæ as well as the nuclei no longer exist. Although this kind of degeneration is more common after acute diseases, it is not unfrequently found in progressive muscular atrophy, in which, indeed, all the three kinds of alteration above-mentioned may exist, not only in the same person, but in the same muscle.

Symptoms.—Progressive muscular atrophy differs in many respects from the simple atrophy which is consequent on exhausting diseases or on paralysis, is always chronic, but of variable and uncertain duration. It is irregular and capricious in its invasion. In most instances it first makes its appearance in the upper extremities, especially on the right side. The muscles of the hand are generally those which are first attacked—the thenar eminence, then the hypothenar, and the interossei. When the interossei are much wasted, the hand presents the appearance of a bird's claw, or what Duchenne termed the *main en griffe*. The atrophy may extend up the limb, and then the flexors and extensors of the fingers, and often the muscles at the back of the forearm, become affected. The disease may also involve the muscles of the arms and trunk —the biceps, deltoid, triceps, pectoral, latissimi dorsi, rhomboidei, extensors and flexors of the head, sacro-lumbales, the abdominal muscles, and the muscles of respiration and deglutition. In some instances the atrophy begins in the muscles about the thorax, and proceeds to a considerable extent, while the arms may escape. In other instances it is limited to the muscles of the forearm. Occasionally it spreads to the lower limbs, but seldom begins there.

A variety of alterations in the shape and position of the trunk and limbs is produced by this irregular wasting of the muscles, and such

alterations are characteristic of the disease; for in ordinary atrophy following exhausting diseases the wasting of the muscles is uniform.

Loss of muscular power in the affected parts is one of the first symptoms, particularly after exertion or exposure to cold. The electric contractility of the wasted muscles is often slightly diminished. Still it is of great importance to note that the wasted muscles respond to the faradaic as well as to the voltaic current, unless the wasting has reached its final stage when healthy muscular fibres are almost wholly absent. The patient's movements are awkward, and there is a certain loss of muscular co-ordination, in consequence of the unequal wasting of the muscles, and the alteration in their relative force or antagonism. At an early period the affected muscles are subject to cramps, fibrillary tremors, and twitches. In some cases there is a variable degree of cutaneous anæsthesia, but usually the sensibility is unimpaired; while in about half the cases more or less pain is experienced in the atrophied muscles, or before the atrophy commences. When the muscles of the face are affected its expression is singularly altered, and the saliva dribbles from the mouth. The tongue is frequently shrunk and shrivelled from atrophy of its muscles, and articulation is imperfect; in this case, however, such signs and symptoms are usually regarded as pertaining to a distinct disease (*see* Labio-Glosso-Laryngeal Paralysis). When the apparatus of deglutition is involved, cough is excited on swallowing liquids, which frequently escape through the nose; when the muscles of respiration are much wasted, there is difficulty of breathing, and the patient commonly dies from some bronchial attack, in consequence of his inability to expectorate the mucus.

Diagnosis.—This is usually made without much difficulty. The fact of the slow progress of the disease, with the successive implication of different muscles or groups of muscles, is very characteristic. It is distinguished from cases of paralysis followed by muscular atrophy, by the fact that there is no paralysis first, and atrophy after, as in these cases, but rather a weakness which increases *pari passu* with the atrophy. Then, again, in progressive muscular atrophy the muscles still respond to faradisation, whereas in post-paralytic atrophy this is very apt not to be the case, and we have instead to do with some form of the 'reaction of degeneration.' *See* Paralysis.

Prognosis.—From what has been already said it is evident that progressive muscular atrophy is a malady of the gravest nature. The only probability of effecting a cure, is when the disease can be treated in its earliest stage, when the disorder of the nervous centres is merely functional, and before any organic lesions have supervened.

Treatment.—When the disease arises from the influence of damp and cold, or from over-exertion, these causes should, of course, be avoided. Warm clothing and warm baths—particularly the waters of Aix-la-Chapelle—are to be recommended. If there be reason for suspecting a syphilitic taint, iodide of potassium, or even mercury, if necessary, should be administered. In other cases cod-liver oil, phosphorus, mineral tonics, and arsenic have been found useful. But galvanism in the early stages of the disease has proved the most useful of remedies. The galvanic current should be applied to the spinal column, especially in the cervical region. When we consider that in the more advanced stages of the malady lesions of the spinal cord are induced, it is questionable whether the application of counter-irritants—especially blisters—to the spine, has had a sufficient trial.

J. Lockhart Clarke.

**PROLAPSUS** (*pro*, forward, and *labor*, I slip).—This word signifies that an organ or structure has fallen or slipped down, but implies a greater degree of displacement than *procidentia*; so that the organ or structure may protrude through a natural or artificial orifice. The condition is of most importance in connexion with the rectum and the uterus. *See* Procidentia; Anus, Diseases of; and Womb, Diseases of.

**PROPHYLACTIC** } (πρὸ, before, and
**PROPHYLAXIS** } φυλάσσω, I guard).
These terms are used in connexion with treatment, and indicate the means employed for the prevention of disease. *See* Disease, Treatment of.

**PROSOPALGIA** (πρόσωπον, the face, and ἄλγος, pain).—Prosopalgia signifies pain about the face. It may depend upon neuralgia of one or more branches of the fifth pair of nerves (*see* Tic-Douloureux). Its paroxysmal character, unilateral position, and anatomical localisation will indicate this form. Another form is of rheumatic origin. In this the pain is more or less constant, diffused about the face or forehead, and does not follow the course of a nerve-branch. Movements, and especially stooping, increase it. Occasionally such pain is of syphilitic origin, and is especially apt to occur in connection with the appearance of the secondary rash.

Diagnosis. — In rheumatic prosopalgia the pain is diffused and increased by pressure. If it depend on syphilitic periostitis there will be tenderness on pressure, and the parts will be swollen and less elastic than normal. There will also very likely be a certain amount of fever; and the pain will be increased at night.

Treatment.—Muriate of ammonia in half-drachm doses, dissolved in half a tumbler of water, should be given every four hours. If there be any evidence of syphilitic infection, iodide of potassium should be taken, in doses of from ten to twenty grains every four hours.

For the rheumatic form of face-ache five grains of iodide of potassium, with thirty grains of bicarbonate of potash, should be given every four or six hours, after the administration of an aperient. This may be followed up by quinine or iron. Locally a mixture of equal parts of camphor, choral, and vaseline may be applied; or a liniment containing chloroform, belladonna, and opium. Decayed teeth should be extracted.

T. Buzzard.

**PROSTATE, Diseases of.**—Synon.: Fr. *Maladies de la Prostate*; Ger. *Krankheiten der Prostate.*

It is not proposed in a work principally devoted to medical subjects to deal at all fully with the affections of the prostate gland; the present article must, accordingly, be taken rather as an index to guide the practitioner in his diagnosis, than as anything approaching a complete disquisition on their pathology or treatment.

General Relations.—The points of practical importance in connection with the anatomy of the prostate are as follows:—In the examination of the rectum the healthy prostate is felt as a firm substance in the middle line, somewhat divided into two lateral lobes. The whole organ is about 1½ inch in width, with its apex opposite, namely, in the recumbent posture below, the apex of the pubic arch; that is, about 1½ inch from the anus, in a moderately thin subject, but much further in a very fat one. The whole gland is 1½ inch in length, its posterior limit being usually about three inches from the anus —in other words, about the distance to which the forefinger can reach. From this it may be deduced that the *trigonum vesicæ* commences immediately behind it, and therefore that a fully distended bladder masks more or less completely the natural outline of the gland. It may thus also be gathered that the vesiculæ seminales are beyond the ordinary reach of the finger, and that when these are infiltrated by disease, their apices, or perhaps only the vasa efferentia, can be detected. The practitioner should by no means neglect the digital examination of the prostate, as it will often yield information of the greatest value. The deviations from the normal type he may expect to meet with are—uniform or partial enlargement from simple hypertrophy, or from chronic or acute inflammation, in the latter case possibly attended by a sense of fluctuation, due to abscess; irregular hardness, most marked about the vasa efferentia, depending on a tubercular deposit; the existence of small hard nodular masses, which are calculi in the substance of the gland; or the irregular enlargement caused by a new growth. It must be borne in mind that tumours or abscesses originating in neighbouring parts may surround the prostate and completely mask its outline; thus the writer has met with a case of a large hydatid cyst between the rectum and the bladder that rather closely simulated malignant disease of the prostate, and effectually prevented its actual condition from being determined. It will not be forgotten that a certain degree of tenderness of the prostate does not imply a deviation from health, and that a more or less considerable enlargement in old age is so common as to be almost reckoned by some authors as normal. The effect of this enlargement on micturition will be mentioned further on. The copious plexus of veins which surround the prostate communicates fully with those of the penis and rectum; and it is not unimportant, from a clinical point of view, to remember that these are thus connected not only with the systemic, but with the portal circulation. These veins may become the seat of phlebitis and its sequelæ from various causes.

The principal diseases of the prostate may be considered in the following order:—

1. **Prostate, Hypertrophy of.**—The results of Sir Henry Thompson's observations (*Clinical Lectures on Diseases of the Urinary Organs*) were, that one-third of all men over fifty-five have some enlargement of the prostate; but that a comparatively small number of these suffer any inconvenience from it; and that it usually begins between the ages of fifty-seven and sixty, though it may more rarely commence later. Very considerable enlargement of the lateral lobes may cause no inconvenience; but if the part which forms the floor of the prostatic urethra, the so-called middle lobe, be even slightly enlarged, difficulty in micturition is sure to result. It is thus easy to understand how a simple hypertrophy may reach enormous dimensions without giving rise to symptoms, while those which are caused by the enlargement of a prostate, which feels almost normal to the finger introduced into the rectum, may, on the other hand, be very severe indeed.

Symptoms.—The symptoms are briefly these: The stream of urine becomes dribbling, and there is an obvious difficulty in emptying the bladder; there is frequency of micturition, especially at night and in the early morning; perhaps a little pain before the act, but none afterwards; and no alteration in the characters of the urine. If unrelieved, these early symptoms are followed by incontinence, depending upon over-distension of the bladder; and, from the same cause not improbably, cystitis and dilatation of the bladder, dilated ureters, and, perhaps, pyelitis and chronic interstitial nephritis. Patients with chronic hypertrophy of the prostate usually suffer from time to time from attacks of acute congestion, such as are described below.

Anatomical Characters.—The structure of a hypertrophied prostate is but a slight modification of that of the gland itself.

Treatment.—In regard to treatment of hypertrophy of the prostate it is only necessary here to give two words of warning. First, that most of the evils resulting from this condition depend upon the fact that the bladder is never emptied; it is essential, therefore, that the patient's powers in this respect should be ascertained without delay by catheterisation, and if it be discovered that a certain amount of residual urine remains, he should be taught to pass an instrument himself, and directed to do so at least once a day. Secondly, cystitis has often been caused by setting up putrefaction of the urine by a catheter not surgically clean; the simple precaution of lubricating it with carbolised oil prevents with certainty this catastrophe. The reader must consult surgical works as to the difficulties which an enlarged prostate offers to the introduction of a catheter, and the manner in which they may be overcome.

2. **Prostate, Congestion of.**—Congestion is a condition which follows on chronic hypertrophy, and is commonly known as 'an attack of the prostate.'

Symptoms.—An old man, suffering from the symptoms above described, is suddenly seized—as the result of some indiscretion in diet, an exposure to cold, or some other apparently trivial cause—with complete retention, accompanied by bloody urine, possibly a raised

temperature and quick pulse, and considerable local uneasiness. If the case do not improve, and especially if the urine be allowed to putrefy, the tongue becomes dry and brown, the pulse more rapid and more weak, and the patient passes into a low typhoid condition, which is not unlikely to end fatally.

Treatment.—The treatment is in large measure surgical, consisting in the proper passing of catheters; but scarcely less important is the careful regulation of the bowels; and the administration of a diet sufficiently light, and yet not too lowering, together with, in most cases, a certain amount of stimulant, for it must be remembered that the patient is probably weak, and that death from asthenia is much to be dreaded. The writer would urgently insist on the importance of preventing putrefaction of the urine, which is the most fertile source of death in such cases; he can affirm from experience that this end may be attained by the thoughtful employment of antiseptic treatment, even in those cases in which it becomes necessary to keep the bladder empty by tying a catheter into the urethra.

**3. Prostate, Chronic Inflammation of.**—Synon.: Chronic prostatitis.—This is not an uncommon affection amongst young and middle-aged men, depending most frequently on a prolonged gonorrhœa, in which the prostatic part of the urethra has been involved.

Symptoms.—The symptoms of this disease resemble rather closely those depending upon stone in the bladder, namely, frequent micturition, with a feeling of heat and weight in the perinæum, and pain along the penis, extending to the tip; there is also at times a little blood passed at the end of micturition; and all the symptoms are aggravated by exercise. Generally there are frequent nocturnal emissions. The urine is cloudy, and on standing yields a mucopurulent deposit. A rectal examination shows that the prostate is enlarged, sometimes very slightly, and seldom to any great extent; it is always tender. The diagnosis can scarcely be made without passing the sound.

Treatment.—The treatment consists in rest, the administration of laxative medicines, and the application of blisters or some other form of counter-irritation to the perinæum; alcoholic stimulants are to be avoided; and the urine should be rendered bland by alkalies and diluents, as in cases of urethritis.

**4. Acute Inflammation of the Prostate.**—Synon.: Acute prostatitis.—Acute prostatitis may arise as the result of a gonorrhœa, or cystitis; from the irritation produced by calculi or other mechanical cause; perhaps sometimes idiopathically, or from exposure to cold or wet; and from undue sexual excitement, or the too free use of alcohol if gonorrhœa be present. This may occur in men of any age, and is accompanied by symptoms such as those depending on chronic inflammation, but much more intense; the frequency of micturition and pain during the act causing sometimes almost unbearable agony, and the dysuria amounting in some cases to complete retention, while the tenderness of the gland is very great, a condition which makes an action of the bowels very painful. Such cases may terminate by becoming chronic; they may undergo complete resolution; or suppuration may occur; in any case there will probably be some elevation of temperature, and in the event of the formation of abscess there may be great and sudden rises and falls, accompanied by rigors and sweatings, with a dry, brown tongue, forcibly suggesting pyæmia. Prostatic abscess may burst into the rectum, bladder, or perinæum.

Treatment.—The treatment of acute prostatitis consists in rest, and carefully-regulated diet; diluent and alkaline medicines; purgatives; local blood-letting from the perinæum, by leeches or otherwise (some French surgeons have recommended the application of leeches to the interior of the rectum); with hot fomentations, and morphia suppositories. If an abscess forms it may be opened through the rectum, but it is better to incise it through the perinæum, as this plan is most likely to prevent the formation of that most troublesome and almost incurable condition, a recto-vesical fistula.

Abscesses sometimes form *around* the prostate (periprostatic). They are not so likely to involve the danger of the formation of a recto-vesical fistula; and they should be treated by early incision.

**5. Prostate, Tubercle of.**—This, though not a common affection of the prostate, occurs perhaps more frequently than is generally supposed, and is of great interest to the practitioner. It is usually a part only of a more or less general affection of the genito-urinary tract. Thus in cases where the epididymes are hard and swollen, and the cords knotty from tubercular deposit, the finger introduced into the rectum will probably detect a hard nodule in one or both of the vasa efferentia. This, if seen *post mortem*, is found to consist of a tubercular or cheesy mass, and if the condition have advanced further, the prostate itself may have become involved; there may be either separate nodules of tubercular deposit in a more or less advanced state of cheesy or, more rarely, calcareous degeneration; or the whole gland may have become hollowed out into an irregular cavity, filled in part with cheesy material, and discharging pus.

Symptoms.—This disease may begin in childhood, or in adult life. Its symptoms are most obscure. At first there are probably none at all, but as the disease advances, there will arise those of tumour of the prostate, together with those of abscess; that is, there will be occasionally blood, and generally pus, in the urine; frequency and pain in micturition; tenderness and swelling in the rectum, and so forth. Abscess from this cause has been known to burst into the peritoneum.

Treatment.—The treatment can only be palliative, and must be directed to the relief of the symptoms as they arise; but at the best it is most unsatisfactory. Occasionally it may be possible to open a tubercular abscess through the perinæum, but it is open to doubt how far such a procedure is to the advantage of the patient.

**6. Prostatic Calculi.**—These are small bodies, generally multiple, formed in the glands of the prostate, usually late in life, but occasionally in comparatively young men. They probably begin as a deposit of animal matter.

but later are made up principally of phosphate, and partly of carbonate, of lime. They may produce no symptoms at all, or they may project into the urethra, and give rise to great irritation at the neck of the bladder, and the symptoms of vesical calculus; such will also be present if, as sometimes happens, they convert the whole gland into a single cavity, in which the calculi lie side by side. In this case they will be felt through the rectum, rubbing against one another; and indeed prostatic calculi are, as a rule, to be felt in this situation.

Vesical calculi of considerable size may become encysted in the prostate, and on the other hand prostatic calculi may find their way into the bladder. Prostatic calculi may give rise to abscess.

If any treatment be required, it is purely surgical, and must consist in the removal of the stones by forceps, a lithotrite, or a perinæal incision.

7. **Prostate, Phleboliths of.**—The pathologist very often meets with phleboliths in the veins surrounding the prostate, the result no doubt of old phlebitis.

8. **Prostate, Tumours of.**—The so-called *fibrous tumours* of the prostate are in all probability simply local hypertrophies, and are composed principally of plain muscular tissue. *Cystic disease* is described as a pathological rarity, the gland being occupied by numerous cysts, containing serous or mucous fluid. *Melanosis* of the gland has also been observed. *Cancer* of the prostate occurs not very unfrequently, and is usually soft, though it is sometimes hard enough to be worthy of the name of scirrhus. The writer would speak with great caution of malignant tumours of the prostate; such as he has himself examined have been cancers, with a very irregular arrangement of both stroma and epithelial cells.

Tumours of the prostate may be at present considered as beyond the reach of surgical interference, though suggestions for their removal have been lately gravely made in Germany.

9. **Prostate, Atrophy and Absence of.**—Atrophy of the prostate is said to occur as the result of pressure, sometimes from an unascertained cause, or from simple senile decay. Congenital absence of the prostate has also in rare cases been observed, but is of little clinical interest.

R. J. Godlee.

**PROSTRATION** (*pro*, forward; and *sterno*, I stretch).—This word signifies both the act of overthrowing, and the condition of being overthrown, overcome, or depressed. In medical science it is generally employed in the latter sense; and is used to express a condition of system in which the bodily energies as a whole, or the more active of them, have so completely succumbed to the effects of injury, disease, or powerful emotional influences, that they cannot be made to respond to ordinary stimuli. When prostration affects the *whole* system the patient is said to suffer from *general prostration of the vital powers*. The principal forms of prostration of a *single* system, on the other hand, are—(1) *muscular prostration*, in which there is complete exhaustion of the voluntary muscles; and (2) *nervous prostration*, in which the nerve-centres, and especially those associated with the mind, are so completely overpowered that sensation and motion appear to be in a measure temporarily suspended.

The causes, symptoms, and treatment of prostration in its several forms are more fully discussed in other articles. *See* Collapse; Debility; Exhaustion; Shock; and Syncope.

J. Mitchell Bruce.

**PROXIMATE CAUSES** (*proximus*, nearest).—A synonym for the immediate or exciting causes of disease. *See* Disease, Causes of.

**PRURIGO** (*prurire*, to itch).—Synon.: Fr. and Ger. *Prurigo*.

Description.—Prurigo is the disease of itching; but, as there are various forms of pruritus or itching of the skin, it becomes necessary to determine what, besides itching, constitutes prurigo.

*Pruritus* is an excited state of the nerves of the skin, and as such, is associated with various forms of skin-affection, for example, with scabies, eczema, and urticaria; but in these affections there is a difference in the cause of the disease. In scabies and eczema the cause lies in the tissues of the skin; in urticaria, on the contrary, it is present in the nerves themselves. Hence urticaria is denominated a neurosis, and *prurigo* is also a neurosis which leads onwards to a defective nutrition of the skin. What especially characterises prurigo is the combination of pruritus with an altered state of the skin, consequent on defective nutrition; and, as a rule, it may be said to be restricted to the elderly period of life, when nutritive power in general is weakened or exhausted.

The quality of the itching in prurigo is not so much intensity, for the itching of chronic eczema and simple neurotic pruritus from reflex causes is often more severe. Its especial character is its pungency, which resembles a burning and gnawing of the flesh; and also its mobility, suggesting the idea of animals creeping and eating their way through the substance of the skin. The degree of severity of the pruritus has suggested the names *mitis* and *formicans*—idle terms which ought to be abandoned; and as much may be said of the epithet *senilis*, inasmuch as general prurigo is necessarily a disease of an ill-nourished skin, and especially of the kind of defective nutrition which is incident to old age.

If we take, as factors, an ill-nourished integument, in an elderly person; a dry, hard uneven skin, discoloured from irregular pigmentation, fatless, and adhering loosely to the fasciæ beneath, suggesting the idea of leather or parchment; and an irritable nervous system, we shall then have a case deserving the name of prurigo. Moreover, to this state of skin we must add papules raised upon the surface, with heads torn off by scratching, and capped with small black crusts of desiccated blood; and abrasions caused by fierce and incessant scraping with the nails. All these conditions taken together constitute a true case of chronic prurigo, a real *prurigo senilis*.

Varieties.—Prurigo is a general affection of

the skin, but it is likewise met with occasionally as a local disease, in the integument around the anus, *prurigo ani*; and in the folds of the clitoris, *prurigo clitoridis*. These latter cases are always accompanied with altered nutrition of the integument, more or less condensation and hardening of the tissues, and thickening of the epithelium. The symptoms otherwise are the same as those of general prurigo, but are often remarkable for their intense severity.

Pathology.—Prurigo is essentially neurotic in its nature; a feeble state of nerve-function gives rise to the altered nutrition of the integument, and irritability of nerve-structures to pruritus.

Prognosis.—The disease is obstinate and enduring, vexatious to the patient, and tending to aggravate general irritability, but not hazardous to life. Occurring in old age, with a tendency to increase, it is apt to last for years. *Prurigo clitoridis* is one of the most rebellious of disorders, and has a tendency to degenerate into epithelioma.

Treatment.—The indications for treatment are to tranquillise the nervous system generally, and to improve the nutrition of the tissues of the skin. For this purpose the digestive organs should be regulated; a generous and nutritive diet enforced; and recourse had to nerve-tonics as well as to general tonics. Cod-liver oil is often a useful remedy, and will be assisted by quinia, strychnia, and phosphorus. Arsenic is indispensable. Sedatives are frequently required to relieve pruritus and procure sleep; and for this purpose the bromides and chloral hydrate will do good service, or in some constitutions hyoscyamus and morphia. Violent exacerbations of pruritus are best controlled by single large doses of quinia, namely, five to ten grains.

Locally, the heat and shampooing of the Turkish bath, frequently repeated and steadily pursued, may be regarded as curative in most cases. This should be succeeded by thorough inunction of the skin with some bland unguent, such as vaseline; and a wash-leather covering should be worn next the skin. Sponging with hot water or hot decoction of poppy-heads will relieve the pruritus for awhile, and in some instances lotions of tar, and almond emulsion, with borax and hydrocyanic acid, are very successful.

Erasmus Wilson.

**PRURITUS** (*prurire*, to itch).—Synon.: Fr. *Prurit*; Ger. *Jucken*.

Definition.—A form of perverted sensation of the skin, and most external parts of the mucous membranes, characterised by itching.

Ætiology.—This symptom accompanies those skin-diseases which involve the uppermost papillary layers of the cutis, in which lie the ends of sensory nerve-filaments. As a rule, it is absent in those which attack the lower layers, for example, most syphilitic rashes and leprosy. It may depend on any of the following causes:—

(1) *Local* irritation from rough clothing, parasites (scabies, pediculi, pityriasis versicolor, tinea tonsurans and circinata), and unhealthy discharges (saccharine urine, leucorrhœa). Perhaps the winter pruritus of Hutchinson and Duhring, which is clearly in some way due to the local effects of cold, should be placed here.

(2) *Inflammations* of the skin, including all forms of eczema, but especially the papular (lichen), psoriasis in the early stage, and, more rarely, pemphigus. It exists to a slight degree in roseola; and much irritation sometimes follows the pustular rashes caused by croton oil and tartar-emetic ointment. Mucous patches and all forms of papular syphilide, *if desquamating*, may itch.

(3) *Reflex irritation* from distant organs, such as the uterus and stomach in urticaria, and the kidneys in Bright's disease.

(4) The presence of certain *substances in the blood*, such as the bile-acids in jaundice, and copaiba.

(5) *Undiscovered causes*, as in true prurigo and the lichen urticatus, or strophulus, of children (*see* Lichen; Prurigo; and Strophulus). Kaposi admits a *pruritus cutaneus universalis* as a true idiopathic neurosis.

Symptoms.—Pruritus may be local or general, slight or severe, continuous or intermittent. It is generally most marked at night. It is usual to describe three special local forms.

(α) *Pruritus genitalium.*—This form is chiefly found in women with uterine disease, such as a granular condition of the os uteri, or during pregnancy, or at the change of life. Diabetes is a frequent cause, and should always be sought for. In men *P. scroti et penis* depends on eczema or uncleanliness. Pruritus on and around the pubes should always suggest the presence of *pediculi pubis*.

(β) *Pruritus ani.*—This is usually connected, in adults, with piles, eczema, or profuse sweating; and in children with thread-worms.

(γ) *Pruritus senilis* occurs in people at or over sixty, and most often depends on the presence of *pediculi vestimentorum*, though in rare instances it seems to be a pure neurosis.

Diagnosis.—It is essential to remember that pruritus is most often a symptom of external irritation, and to search for the various causes enumerated above, especially animal parasites. The possible presence of the latter should not be ignored because of the social position of the patient.

Treatment.—For general pruritus, if no cause can be found, the two best remedies are tar and sulphur. Tar may be used as a lotion—for instance, the following: ℞ Liquoris carbonis detergentis (Wright's), ℥ ss; glycerini, ℥ j; aquam ad ℥ x. Sulphur may be employed thus, as a bath: ℞ Potassii sulphidi, ℥ iv; aquæ calidæ, cong. xxx. Flannel should be removed from immediate contact with the skin. Carbolic acid with opium sometimes gives relief in the following form: ℞ Tincturæ opii, ʒ j; acidi carbolici, ʒ j; spiritus vini rectificati, ℥ vj. Internal remedies, such as potassium bromide, strychnia, conium, and morphia, are of very doubtful value; sulphate of atropia in 1 milligramme doses has proved effectual in a few cases of obstinate urticaria. In pruritus genitalium extreme cleanliness and a borax lotion are the best remedies: ℞ Glycerini boracis ℥ ij; aquam ad ℥ vj; ft. lotio. For pruritus ani, a calomel ointment—such as: ℞ Hydrargyri subchloridi, ʒ j; adipis

benzoati, ℥j; ft. unguentum—is to be recommended. *See* Eczema; Phthiriasis; Scabies; and Urticaria. Edward J. Sparks.[1]

**PRUSSIC ACID, Poisoning by.**—Synon.: Fr. *Empoisonnement par l'acide cyanhydrique*; Ger. *Cyanwasserstoffsäurevergiftung.*

Prussic or hydrocyanic acid is one of the best known and most deadly of poisons. In the anhydrous condition it is stated to kill with almost lightning-like rapidity. Prussic acid is met with in commerce only in a diluted state. In this country two strengths of prussic acid are usual, the Pharmacopœial acid, containing two per cent., and the so-called Scheele's acid, containing about five per cent., respectively, of anhydrous prussic acid in aqueous solution. The soluble cyanides, more especially cyanide of potassium, largely used by photographers and by electro-platers, are common articles of commerce, and produce the same deadly results as the acid itself. The fatal dose of prussic acid is the equivalent of about one grain of the anhydrous acid.

Anatomical Characters.—In persons who have died of prussic acid poisoning the eyes are glistening; the extremities are blue; the face is pale or livid; and the lips are cyanosed. The blood throughout the body has frequently the peculiar odour of the acid, and is of a dull hue, with a peculiar bluish cast—a glimmering appearance. The stomach is sometimes reddened, but not more than is common after other asphyxial modes of death.

Symptoms.—In fatal doses the symptoms of prussic acid poisoning set in very speedily; and in consequence of the readiness with which this poison is absorbed from the alimentary canal, and diffused throughout the circulation, the onset of symptoms is reckoned by seconds rather than by minutes. Occasionally the patient may be able to walk into an adjoining room, to compose himself in bed, or perform like actions; but it is rarely that he will have time to dispose of the cup, glass, or bottle, in which the poison was contained before he is taken seriously ill. The symptoms may be divided into three stages. The *first stage* is very brief, and manifests itself by difficult respiration, slow cardiac action, with a tendency of the heart to stop in diastole, whilst its beats are irregular. There is disturbed cerebration, and an awe-stricken aspect of countenance. This preliminary stage speedily ushers in the *second* or *convulsive stage*, the onset of which is occasionally signalised by a piercing shriek, though this is less frequently observed in man than in animals. With widely dilated pupils, the patient is suddenly thrown into violent clonic and tonic convulsions. The respiration is marked by shortness of inspiration, and prolonged efforts at expiration. The countenance becomes cyanotic. Vomiting is commonly observed; and the urine, fæces, and even semen in the male are spasmodically evacuated. The patient now sinks down, probably in a state of unconsciousness, and with complete loss of muscular power. The convulsive stage speedily passes into the *third*, or, as it may be termed, *asphyxial stage*, with slow, gasping, stertorous respiration, extreme collapse, loss of pulse, and more or less complete paralysis of motion. The skin is cold, clammy, and cyanosed. Death may be ushered in with irregular spasms. The onset of symptoms being rarely delayed beyond one or two minutes, death may occur within two or three minutes more. Power of volition is rarely continued in fatal cases for more than two minutes after taking the poison. Fifteen minutes is the longest interval which has been known to elapse between the taking of the poison and the commencement of symptoms; and then the patient recovered. Should the patient survive for thirty minutes good hopes may be entertained of recovery. The longest period which is known to have elapsed between the taking of the poison and death was one hour and a quarter.

Diagnosis.—This is rarely difficult. The *foudroyant* character of the illness, and the usually speedy death of the patient, coupled with the peculiar odour of the acid, and the finding of a cup or glass containing the remnants of the dose, seldom leave any doubt as to the nature of the case. Nitro-benzol poisoning closely simulates prussic acid poisoning, however, except that the onset of symptoms is generally much later in nitro-benzol poisoning than when prussic acid has been taken. Nevertheless, when crude bitter-almond oil, impure from the presence of prussic acid, has been swallowed, the close similarity between the odour of the oil and that of nitro-benzol may lead to error. Fortunately, the same treatment may be adopted in both cases.

Prognosis.—This in all cases is very doubtful; and no general rules can be laid down.

Treatment.—Prompt inhalation of the fumes of ammonia should, if possible, never be neglected. The successive administration of a solution of the mixed per- and proto-salts of iron, followed by an alkaline carbonate, so as to convert the acid into an inert ferrocyanide, has been recommended on purely chemical grounds. There is, however, seldom or never time to admit of this elaborate treatment. A more practicable mode is to treat the patient with alternate douches of warm (115° Fahr.) and cold water, so as to stimulate the respiratory functions; artificial respiration may also be employed, together with friction of the limbs. An emetic should be administered. Faradaic currents of electricity to the cardiac region should not be neglected. Atropine is not, as has been asserted, a true physiological antidote to prussic acid; but, injected subcutaneously, it may be of use as a respiratory stimulant. Spite of all treatment, the patient usually succumbs. T. Stevenson.

**PSEUDO-** (ψευδής, false).—This is used as a prefix to various names of conditions, and signifies that they simulate certain diseases or conditions which they really are not; for example, *pseudo-angina*, *pseudo-asthma*, and *pseudo-cytosis.*

**PSEUDOCYESIS** (ψευδής, false, and κύησις pregnancy). A synonym for spurious pregnancy. *See* Pregnancy, Diseases and Disorders of.

**PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.**—Synon.: *Lipomatosis musculorum luxurians*; Fr. *Paralysie pseudo-hypertrophique*; *Paralysie myosclérosique*; Ger *Atrophia musculorum lipomatosa.*

[1] Revised by Dr. Alfred Sangster.

Definition.—This is a progressive muscular paralysis, appearing mostly in boys, in which the ultimate fibres of the affected muscles atrophy, but the muscles themselves appear to be hypertrophied, in consequence of the development of interstitial fat and fibrous tissue.

Ætiology. — Pseudo-hypertrophic muscular paralysis is a disease of boys, very few cases having been observed in girls or in adults. In a large number of cases it begins in infancy, the weakness becoming manifest at the time the child should begin to walk. In some instances it has been found to be hereditary, several children in the same family having been affected. Nothing definite is yet known as to the direct causation of the malady.

Anatomical Characters. — In the earlier stages of the malady, the muscles chiefly affected are those of the legs and lower part of the back, particularly the gastrocnemii, the posterior muscles of the thigh, and the erectores spinæ. These muscles are enlarged, and they are felt to be firm and hard. This is not, however, due to true hypertrophy, for if a portion of the muscle be removed during life by the *emporte-pièce*, an instrument constructed by Duchenne for this purpose, the muscular fibres are found to be atrophied, and much of the apparent bulk is seen to be due to an interstitial development of fat and fibrous tissue. Subsequently, the remaining muscles of the trunk, upper limbs, and sometimes even of the face become similarly affected, in most cases these muscles merely wasting without any apparent enlargement, but in other cases the apparent hypertrophy being present in the upper as well as the lower half of the body. In the later stages of the disease, the whole of the voluntary muscles, including those which at first were enlarged, become more or less wasted. The diseased muscles are found after death to be composed in a great measure of ordinary fat-cells. The true muscular substance has to a considerable extent disappeared, and only a few ultimate muscular fibres are seen running at intervals through the fat. Some of these ultimate fibres retain their normal size and appearance; others are much decreased in size, though still showing the striation; only a few of the atrophied fibres have lost their striation, and become granular. The diseased muscles also contain a considerable quantity of fibrous tissue, some of which is probably the remaining sheaths of muscular fibres which have undergone complete atrophy. There is less fat and fibrous tissue in the wasted muscles than in those which are pseudo-hypertrophic, but the changes in the ultimate muscular fibres are the same in both.

Some doubt still exists as to the pathological anatomy of the spinal cord in this disease. Several competent observers, such as Cohnheim and Charcot, have failed to find any morbid changes in the nervous system. Lockhart Clarke and Gowers have, however, discovered important alterations in the spinal cord in a case of this disease. The principal change was extensive disintegration of the grey matter at the centre of each lateral half of the cord, and of the anterior commissure.

Pathology.—It has been suggested by Friedreich and others that pseudo-hypertrophic muscular paralysis is essentially the same disease as progressive muscular atrophy, and this view is probably correct. The two diseases differ in this respect, that the former always begins in the lower limbs, the muscles of which are more exercised than the arms in children. The enlargement of the muscles might be explained by supposing a compensatory growth in the early stages of the malady in those diseased muscles which have the most important functions; and the posterior muscles of the legs and back have the important duty of keeping the body erect on the legs. It is a fact that the pseudo-hypertrophied muscles retain much greater power than the muscles which are merely atrophied.

Symptoms.—The symptoms of a well-marked case of pseudo-hypertrophic muscular paralysis are very striking, and cannot easily be overlooked or mistaken. When the child is stripped, the muscles of the calves are seen to be larger and firmer than natural, and the same apparent hypertrophy may be present in the muscles of the thigh, the glutei, the lumbar muscles, and others. Occasionally the muscles of the upper half of the body exhibit a similar increase in size, but much more frequently they are wasted, so that the emaciation of the upper half of the body contrasts strongly with the apparent excess of muscular development in the lower half. The next most obvious symptom is protuberance of the belly. There is no abdominal enlargement, but the antero-posterior curvature of the vertebral column in the lumbar region is much exaggerated, and the shoulders are thrown back. This unnatural curve is not caused by any disease of the vertebræ, for it entirely disappears when the patient sits or lies down. When the child stands, the legs are held apart, and the heels raised off the ground. He walks almost on tiptoe, as in talipes equinus, and with a most peculiar gait—a waddle, as if he needed to balance the body first on one leg and then on the other. Walking soon tires him. If he attempts to go fast he falls, and he is very easily knocked over. He can readily stoop so as to touch the floor, but generally has great difficulty in raising himself to the erect posture, using powerful muscular effort, and having to assist the movement by means of the hands placed on his knees. When sitting, he can recover himself from the bent position with comparative ease. The electro-contractility of the muscles is unimpaired. The general health of the patient is unaffected until the later stages of the disease. In many cases of pseudo-hypertrophic muscular paralysis there is some deficiency in mental power.

Duchenne divides the progress of pseudo-hypertrophic paralysis into three stages:—In the first stage, lasting several months or even one or more years, there is merely weakness of the muscles, causing the peculiarities in the attitude, and in the mode of progression. Little or no enlargement of the muscles has taken place. During this stage proper treatment may bring about recovery. In the second stage the characteristic hypertrophy appears, and the weakness extends to the muscles of the upper limbs. This stage may last for years. In the third stage complete paralysis of most of the muscles of the upper and lower limbs and of the trunk supervenes. The patient lies helpless, unable to change

his position. All the muscles, even those which were formerly hypertrophied, pass into a state of atrophy. The sufferer may live in this weak state until carried off by some intercurrent disease.

Diagnosis. — Pseudo-hypertrophic muscular paralysis has such peculiar and well-marked characters that it cannot easily be mistaken. It is readily distinguished from the various forms of spinal paralysis by the evident enlargement and unusual firmness of the paralysed muscles of the lower limbs. From spinal curvature, depending on disease of the vertebral column, it differs in this respect, that the curve of the spine which is present in pseudo-hypertrophic paralysis disappears when the patient sits or lies down.

Prognosis.—The prognosis is most unfavourable.

Treatment.—This is only available in the first stage, before the hypertrophic symptoms are marked. Duchenne recommends localised faradization and shampooing, and he records two cases which were cured by these means. The writer has seen one case which had entered on the second stage, in which this treatment has completely checked the progress of the malady, and even brought about considerable improvement in the strength of the lower limbs. It is probable that the continuous current might prove useful. General tonic treatment is undoubtedly beneficial, but no medicinal remedies are known to have any special control over the disease.

Alexander Davidson.

**PSOAS ABSCESS.**—Synon.: Fr. *Abcès du Psoas*; Ger. *Psoas abscess*.

Definition.—A variety of spinal abscess, formed by a collection of pus, confined by the fascial sheath of the psoas magnus muscle; conducted by it beneath Poupart's ligament; and pointing in the thigh, in Scarpa's space, external to the femoral vessels.

Such is the ordinary course taken by the pus in psoas abscess, although it is liable to a good many modifications. Thus, the matter may be arrested just above Poupart's ligament, and the abscess occupy the venter ilii; it may make its way into the inguinal canal, and out at the external ring, and simulate a hernia; or, again, it may point above Poupart's ligament, but in this instance the abdominal muscles and fasciæ must have been perforated by ulceration. No real difference exists between the causes of lumbar abscess and psoas abscess; it is rather a question of degree, and of the position of the ulceration, and the initial terms may be regarded as topographical only.

Ætiology.—Psoas abscess is rarely met with before puberty, generally between that period and five-and-thirty years of age; and would seem to be more common in males than in females.

As a result of spinal caries the abscess is more liable to be of the psoas form, if the patient, during the early stages of the disease, has been able to get about.

Anatomical Characters. — Psoas abscess is generally a result of tuberculous osteitis, commencing on the anterior surface, and anterior portion of the cancellous tissue, or in the fibro-cartilages, of the lower dorsal or upper lumbar vertebræ (*see* Spine, Diseases of). It may follow injury, however; and, moreover, may exist independently of diseased bone.

The morbid process is one of ulceration and of suppuration. The tissues surrounding the affected parts become thickened, and confine the pus; whilst, from its sinking down, and from the spreading of the ulceration, the abscess grows in bulk. More rarely, acute inflammation may occur in the substance of, or immediately beneath, the fascia covering the psoas muscle, as in psoitis and peripsoitis.

The pus of the spinal abscess, having gained the abdominal side of the diaphragm, passes into the body of one or other, or of both, psoas muscles; arrives at Poupart's ligament; and commences its downward course, this point being called the 'neck' of the abscess. When once it has passed this point it increases rapidly in size, its appearance being preceded by a bulging in the fold of the groin. Its subsequent course is inwards and downwards, following the line of the inner edge of the sartorius. It may, however, lie over the adductors; or may pass entirely outwards; the direction straight downwards is rare. Cases have been met with where it has divided at the groin; where the matter passed the knee-joint, and pointed at the tendo Achillis; and where it has passed along the course of the profunda femoris vessels.

Sometimes the abscess does not pass beneath the crural arch, but by its expansion forms a well-defined globular tumour in the iliac fossa. In other cases, the pus may find its way into the inguinal canal; into the intestine; or, as is the case in children frequently, over the crest of the ilium, pointing in the buttock.

Symptoms.—The earliest symptoms preceding psoas abscess are generally not well-marked. There is gradual weakness, loss of flesh, a pallid complexion, and loss of appetite. Later on the limb becomes affected; limping occurs during or after walking; and the action of the psoas muscle becomes impaired. Subsequently a soreness, hardly amounting to severe pain, is experienced in the spine or in front of the thigh, aggravated by pressure; or a swelling may appear in the lumbar region, since this particular abscess is merely a form of lumbar. The peculiar symptom of psoas abscess is essentially a fluctuating swelling beneath and extending below Poupart's ligament; generally pointing external to the great vessels; receiving an impulse on coughing; and disappearing, or partially disappearing, on the patient's assuming the recumbent position. It must, however, be remembered that the pus may travel along other channels, or may encroach upon other fascial sheaths than its usual one. Yet its persistence at its 'neck' will materially assist in its physical diagnosis.

The contents of a psoas abscess are pus and tubercular matter, intermixed with flakes of lymph, and particles of bone and fibro-cartilage.

Diagnosis.—The chief point of difficulty in the diagnosis of psoas abscess is that of distinguishing it from iliac or cæcal abscess. In the early stages it is always associated with spinal mischief in young subjects. It points below Poupart's ligament; there is an inclination of

the trunk forwards, and some disturbance of the functions of the psoas; and pain in walking is complained of. Iliac abscess arises in the loose areolar tissue of the iliac fossa, and in some cases may actually get into the sheath of the psoas.

Sometimes the caries commencing in the lower lumbar vertebræ may spread laterally, and rise above the crest of the ilium; and the pus, being discharged backwards, may appear to have commenced with hip-joint disease, as the movements of this joint are impaired. It is important in such cases to place the patient under an anæsthetic, and make a most careful examination.

Again, psoas abscess usually makes its appearance in the groin very suddenly, owing to the giving way of some confining tissue.

Medullary cancer may simulate psoas abscess; particularly if the disease has invaded the spine, and caused a curvature of the lumbar vertebræ. Aneurismal tumours, or blood which has escaped by the rupture of such tumours, may be mistaken for the disease, and particularly when such extravasation has found its way into the sheath of the psoas, and is non-pulsatile.

Prognosis.—As a rule the prognosis of psoas abscess cannot be considered favourable. It is an advanced symptom of strumous dyscrasia; it rarely gets well of itself; it frequently impairs the functions of the spinal cord; and it may terminate fatally by hectic or lesion of the lungs or bowels.

Treatment.—The best method of treatment of psoas abscess is that adopted by Lister, of opening it by free incision antiseptically; inserting an adequate drainage-tube; and dressing it with scrupulous care from first to last (*see* Antiseptic Treatment). The abscess may, however, open spontaneously, and no bad results follow; and, with great care, and the use of the prone couch, the patient may recover.

Good diet, cod-liver oil, iodides, and tonics appear to be the most suitable internal remedies.

Edward Bellamy.

**PSORIASIS** (ψώω, I rub).—Synon.: Fr. and Ger. *Psoriasis.*—This word expresses the effort to relieve itching; hence the word *psora*, applied to the disease eczema by the Greeks, but in modern pathology restricted to scabies. The term has been adopted by the French and Germans as the equivalent of the lepra of Willan, and is at present generally used in that sense. *See* Lepra.

**PSYCHOSIS.** *See* Sycosis.

**PSYDRACIUM** (dim. of ψύδρακες, blisters).—A small blister, or pustule, without inflammatory base; a cold pustule, in contradistinction to *phlyzacium*, or hot pustule.

**PTOMAINES.** *See* Appendix.

**PTOSIS** (πτῶσις, a fall).—A drooping or falling of the upper eyelid, with inability to raise it, due to paralysis of the third cranial nerve. *See* Third Nerve, Diseases of.

**PTYALISM** (πτύαλον, saliva).—A synonym for salivation, or excessive flow of saliva. *See* Salivary Secretion, Disorders of.

**PUBERTY, Disorders of.**—Synon.: Fr. *Troubles de la Puberté;* Ger. *Störungen der Pubertät.*

Of the various periods into which existence is divisible, certainly not the least important, in its pathological aspect, is that intervening between childhood and maturity, when the reproductive powers become developed, and which is known as *Puberty.*

This epoch occurs earlier in warm climates, sanguine temperaments, and highly cultivated and luxurious states of society; it is retarded by the opposite conditions; and in these islands it generally commences between the ages of thirteen and fifteen in females, and a year later in males. Under the age of fourteen, a male is legally supposed incapable of committing a rape; and a female under twelve is deemed incapable of consenting to sexual intercourse. By the Roman law, the period of the commencement of puberty was identical with that at which the individual became liable to military duty. Thus Adrian commenced his service at the age of fifteen.

Puberty cannot, however, be estimated by age alone. Even in this climate, the period of the commencement of puberty varies widely; thus the writer has seen instances of menstruation in children under ten, and has assisted at the delivery of a girl of fourteen years of age. More frequently, however, puberty is postponed beyond the ordinary period, which may be also modified by family or hereditary peculiarities, and the influence of various diseases.

In the first stages of life, the functional differences between the sexes are comparatively slightly marked; but on the approach of puberty these suddenly become prominent, and so obvious does the influence of the uterine system become, that *propter uterum est mulier* is then almost literally the case.

The accession of puberty in the male is attended by a characteristic alteration of the voice, from 'the thin childish treble' to 'the deep manly bass,' owing to the development of the *pomum Adami*, and the elongation of the thyroid cartilage and thyro-arytænoid muscle. About the same time occurs the growth of hair on the skin on various parts of the body. Before this there are observed the development of the male genital organs, the enlargement of the testes and other parts of the sexual apparatus, the secretion of the seminal and other accessory fluids, and the first outburst of the sexual instincts and feelings. So slowly do the successive changes, which mark the occurrence of puberty in the male, proceed, that they are not completed until full age has been passed.

In the female, on the contrary, when puberty is reached, the individual passes at a bound, as it were, from childhood to womanhood, although the structural and functional changes involved in the transition are infinitely more complex and important than is the case in the other sex. Thus the enlargement of the external genital organs is accompanied with a still greater change of the internal organs of generation—the development of the uterus, ovaries, and mammæ, and the commencement of that periodic sanguineous discharge *per vaginam*, the recurrence of which at regular monthly intervals marks the period

within which woman is capable of reproduction.

The writer has found it less easy to discover the true date of first menstruation than have some authorities whose tables are generally relied upon. In the great majority of cases the statements of those he questioned were so indefinite as to be practically valueless, and in only 497 instances did the writer get even any approach to accurate data on this point. Excluding all cases of so-called infantile menstruation, the results of these inquiries may be thus summarised, the mean age being 15:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Under 12 | . . | 4 | menstruated | for | first | time. |
| At 12 | . . | 17 | „ | „ | „ | „ |
| „ 13 | . . | 50 | „ | „ | „ | „ |
| „ 14 | . . | 94 | „ | „ | „ | „ |
| „ 15 | . . | 138 | „ | „ | „ | „ |
| „ 16 | . . | 105 | „ | „ | „ | „ |
| „ 17 | . . | 65 | „ | „ | „ | „ |
| „ 18 | . . | 10 | „ | „ | „ | „ |
| Upwards of 18 | | 14 | „ | „ | „ | „ |

Generally speaking, therefore, between the ages of thirteen and fifteen in our climate, the human female undergoes the change from childhood to puberty; the essential characteristic of this change consisting in a periodic sanguineous discharge, *per vaginam*, resulting from ovulation. The process of menstruation, from its commencement in ovarian congestion, resulting in the discharge of an ovum, its transmission along the Fallopian tube, its transit through the congested uterus, its expulsion thence, together with the disintegrated endo-uterine mucous membrane, and the consequent hæmorrhagic discharge from the denuded uterus, is invariably productive of more or less general constitutional disturbance and mental irritation, so that no woman can be properly said to enjoy the *mens sana in corpore sano* whilst menstruating. When this function has become regularly established, the accompanying constitutional disturbance may be so slight as to be practically unrecognisable. But on the first occurrence of ovulation, few, if any, escape some sympathetic constitutional derangement, and more especially some one or other of the protean forms of hysteria. Hence, under the guise of nearly every disease that may affect a girl at the age of puberty, whether it be spinal, cardiac, pulmonary, or any other disorder, the practitioner must look carefully that he has not to deal with some variety of hysteria, directly resulting from the complex process by which puberty is accompanied.

Undue importance is attached to the non-appearance of menstruation, as the supposed cause of all the ills that female flesh is heir to. In the majority of cases of delayed menstruation the amenorrhœa is the result of constitutional disease, to the rational treatment of which, and not to any utero-ovarian stimulation, should the efforts of the physician be directed. At the same time, the part played by the development of the reproductive system in the transformation scene from childhood to maturity, is unquestionably of the first importance. The morbid influence of the premature indulgence of the newly-awakened sexual appetites at the age of puberty, and the many forms of disease by which the vice of masturbation is avenged by outraged nature, are subjects the medical importance of which it would be difficult to exaggerate, and which it would be impossible to discuss in this article.

Many of the ailments common about the period of puberty, are but accompaniments or forerunners of the functional and organic changes then commencing. More especially is this the case in the female sex. Hence the physician must bear in mind that the headaches, palpitations, symptoms of disordered nervous action, and many of the cases of hæmorrhage from various organs which create so much alarm, are, as Sir Henry Holland long since observed, but evidences of 'new balances struck in the allotment of the blood to different parts; and in the course of such changes, congestions and discharges are prone to occur, the latter relieving or preventing the former.' It is hardly necessary to point out the necessity for careful diagnosis between symptoms thus caused, and the evidences of actual disease; for in the former, the active treatment required by the latter would be not only unnecessary, but positively injurious, by interfering with the progress of those natural functional or organic changes on the establishment of which these symptoms will cease. The circulation is now vigorous; not only is the amount of blood in circulation greater during this period, but also its relative proportions of fibrin and red corpuscles are larger, and hence the roseate hues and plump outlines of early youth.

It is surprising how well young persons at this period bear hæmorrhagic discharges, with which the experienced physician will be slow to interfere, lest by their arrest he may bring on more serious consequences. Many of those cases of hæmoptysis which excite so much alarm, as supposed evidences of pulmonary disease, and the subsidence of which is ascribed to the particular treatment adopted, as well as most cases of hæmatemesis occurring in girls about this epoch, are merely symptomatic of the changes consequent on puberty, and require little or nothing in the way of repressive treatment.

There are few practical subjects more neglected by physicians than the moral hygienic and physical management of puberty. The effect of the evolution of puberty, as the occasional exciting cause of insanity, has been briefly alluded to by Dr. Maudsley and some other writers on mental disease. The influence of over mental stimulation during puberty, as an occasion of the increased proportion of nervous and cerebral disorders, is a subject of the greatest importance. At this period of life the present cramming system of education predisposes to insanity, the organ of the mind being goaded into premature activity, and overstrained in the effort to pass some competitive or other examination, deemed essential to entrance on official, commercial, or professional life. Thus the mental powers are worn out and exhausted before they have attained their perfection. In another respect the modern system is hurtful to the mind; for now-a-days, when education is too often divested of that moral restraint and control formerly held to be essential, 'it proves injurious,' as Dr. Copeland says, 'not only in the way thus stated, but in giving rise to forced, unnatural, overreaching ambitions,

and unprincipled states of society; and these states, in proportion as they are developed, are the parents of crime, insanity, and suicide.'

THOMAS MORE MADDEN.

**PUBLIC HEALTH.** — In all civilised countries laws are made with the intention of removing conditions which injure the health of the people. In the United Kingdom these laws are now very numerous, and almost every year new statutes regulating public health are enacted. The general fault of the laws in this country has been their tentative and permissive character; powers are not infrequently given which there is no obligation to use, and which are therefore not used, and the wording of the Acts has sometimes permitted evasion.

It may be believed that certain ambiguities of expression in the Acts were avoidable, but that they have arisen from the difficulty of determining the proper limits of the action of the State, *i.e.* to what point it is right to interfere with private property, with private enterprise, and with individual responsibilities.

These are difficult questions, for though it is undoubted that the community, as a body, has a just power of setting aside the rights of individuals when necessary for the benefit of all its members; yet it is obvious that such power must be exercised with great discretion, lest the right to property, and the incentive to labour and to self-improvement, should be endangered. Still it cannot be doubted that our sanitary laws have been influenced by an unnecessary timidity, and have been too much hampered by opposing opinions respecting the proper limits of these powers and rights. There are some writers who question whether the State has any right to interfere with individual action; but to this it seems answer enough to say that a community is, after all, nothing but a collection of individuals, whose united action is merely the individual action combined; that such union, as represented by the majority, is a necessity for the security of life and property, and in those cases is always enforced, and that there can be no reason why this combined action should not also regulate the important conditions of public health as well as the relations of property and the conduct of individuals. Practically, also, there are conditions affecting the health of its members with which the community at large alone can deal, and with which, therefore, it ought to deal. It can also be shown that this common action has already been productive of the greatest good in several cases, and is absolutely necessary in order to counteract the ignorance, carelessness, selfishness, and avarice of men.

Although there are many old statutes, and also provisions in the common law of England affecting the public health, the sanitary legislation of England may be said to date from the passing of the Public Health Act of 1848 (11 and 12 Vict. c. 63). That Act was followed between 1855 and 1872 by a variety of public Acts having sanitary objects, besides others of local application. These public Acts have been now consolidated in the great Act of 1875 (38 and 39 Vict. c. 55), an Act for consolidating and amending the Acts relating to public health in England. This Act is cited as the Public Health Act, 1875. It does not apply to Scotland or Ireland, which have their own Health Acts, nor to the Metropolis where former Nuisance Removal and Sanitary Acts continue in force. This statute repeals (except as regards the Metropolis and Scotland and Ireland in certain cases) no less than nineteen Acts,[1] and affects sixteen others. It has not only consolidated but has improved the law, and in several cases has given increased powers to local sanitary authorities.

In addition to this Act two others of importance were passed in the session of 1875: the Artisans and Labourers' Dwellings Improvement Act, 1875, which applies only to the Metropolis and to urban districts in England and Ireland having a population, according to the last census, of 25,000 and upwards. It gives powers to clear unhealthy areas, and to superintend and regulate the rebuilding on such areas. It is likely to prove a very important Act, and doubtless will in time be followed by a statute dealing with smaller populations.

In the same session an Act entitled 'An Act to repeal the Adulteration of Food Acts, and to make better provision for the Sale of Food and Drugs in a pure state' (38 and 39 Vict. c. 63)—short title, 'Sale of Food and Drugs Act'—was passed. It repeals entirely or partially four Acts, and provides for the appointment of public analysts, and for the purchase and examination of food and drugs.

[More recent Acts are (*a*) The Rivers Pollution Prevention Act of 1876, to which reference will be made in the course of the present article; (*b*) The Contagious Diseases (Animals) Act, of 1878, which confers certain powers for the proper keeping of cows and for the protection of milk against injurious influences; and (*c*) the 'Public Health (Water) Act' of 1878, enabling rural sanitary authorities to require the provision of sufficient water-supply. In intention, at least, these Acts fill some serious gaps in the sanitary legislation of the country.]

In the following article a general outline is given of the subject of Public Health. It is, of course, impossible to fill up the details, which require special works for almost every heading. But the outline will show the points which are especially deserving of attention, and which have to be considered both in legislation and in the practical performance of the duties of medical officers of health.

*Condition of Open Lands, Forests, and Rivers.* The drainage of land, so as to carry off water readily and thus to make both ground and air drier, has a great effect on public health. Ague, so common formerly in England, has greatly lessened, and dysentery, which so often went with it, has almost disappeared, in consequence of drainage.

The movements of the ground-water which, by its rises and falls, influences the moisture

[1] The only Sanitary Acts of previous sessions remaining unrepealed are the Bakehouses Regulations Act, the Baths and Washhouses Acts, the Labouring Classes Lodging Houses Acts, and the Artisans' and Labourers' Dwellings Act, 1868.

and the amount of air in the soil, and, through these conditions, alters the amount and rapidity of decomposition therein, has been supposed also to influence health, and to be especially connected with the development of typhoid fever and of cholera. A moist ground is also believed, on tolerably strong evidence, to be favourable to the production of destructive lung-diseases; and there is no doubt that rheumatism and catarrhal affections are more common on damp soils. Although the influence of the ground-water in cholera is questionable, and it is not always active in the production of typhoid fever, it is certain that lowering the level of the ground-water when it is near the surface is often followed by the best results on the general health of the people, and in hot countries malarious diseases have been greatly diminished, even when the lowering of the ground-water has not exceeded a few inches.

Land-drainage operations, as they influence public health, might therefore be undertaken by the State, but, practically, they have been carried on in this country by private and local enterprise, aided of late years by state loans on moderate terms of interest and repayment. In India this question of land drainage is of pressing importance in water-logged and malarious districts, and it is one which in that country must eventually be met by the State, though its magnitude and cost will probably cause the question to be deferred as long as possible.

The regulation of irrigation operations also may become an important matter of State control if sewage irrigation farms increase in number. These farms should not be situated near to houses (not within five hundred yards if possible), and the lands should be properly prepared and drained so that there is no stagnancy of the water. If properly arranged it seems clear that sewage irrigation is not hurtful to the public health. Rice-field irrigation is more difficult to manage, as the water must rest longer on the ground, and underground drainage is less rapid. Rice fields, then, should be situated at a greater distance from houses.

Up to the present time no law in England deals with the subject of land drainage in reference especially to public health, for the Land Drainage Act of 1861 (24 and 25 Vict. c. 133) refers only to agricultural purposes.

The regulation of forests ought to be considered a state matter, as the climate of a country and, therefore, health are greatly influenced by them. The removal of forests produces a variety of direct effects. Greater movement of air over the earth is permitted: the soil is rendered hotter in all temperate and hot countries, colder in northern lands; the air is drier everywhere, because the rainfall is lessened, the ground is drier, and the evaporation from leaves is lessened; the ground is drier, because there is not only less rain but freer evaporation, and the roots of the trees no longer obstruct the movement of the ground-water, which flows off more rapidly. These direct effects have a varying sanitary significance, according to circumstances: for example, increased movement of air may be injurious, if malarious air be no longer kept away from a town, as is supposed to be the case with the Roman Campagna; again, in hilly countries where the trees have been too much cleared off, there occurs aridity of soil as a rule, and greater rapidity in the amount of water passing into rivers during rains, and thus leading to floods. In this island the regulation of forests is not a matter of much national importance; it is otherwise in Germany and France, where laws exist which restrain private action; and in Italy, Greece, and Turkey the condition of the forests requires grave consideration as a matter of public health, as well as of climate and rainfall. In India this is also the case, and there are several important sanitary aspects under which the operations of the Forest Department need to be regarded.

The regulations of rivers, such as the embankments, narrowings, deepenings, and removal of obstructions, have generally been concerned with little else than navigation or the prevention of accumulations; but they are equally important as they may influence the outflow of the land-water from their drainage areas, and in that way may affect the dryness of the soil. In this regard the condition of all watercourses is a matter of importance, and seems obviously a case for state control. It is not, however, usually included in the subjects of public health, and when any large watercourse is out of order, and inundations from the river or from the sea are dreaded, the Crown usually appoints, on the application of the proprietors of the adjoining lands, a Commission of Sewers, under the above Land Drainage Act, to consider what should be done.

In another way the regulation of rivers is of importance. They supply the drinking-water of the community to a large extent, and freedom from contamination is, therefore, necessary. At present this is one of the most difficult questions of public health, and for some years a Royal Commission was engaged in enquiring into the causes and remedies of the pollution of rivers. The chief causes of contamination are the dirty water and sewage coming from towns, and the refuse of trade operations. The former can be best met by irrigation or by filtration through land, though the immense quantity of water to be purified, and the price or position of land, may cause difficulty. The admixture of trade refuse water presents, however, the greatest difficulty; to prohibit the flow into streams would sometimes be to prohibit the trade works.[1] At present there is no settled standard of purity for either town or trade water before its discharge into streams, and it is probable that the standard must vary with the place and trade, and must depend on the composition of the water as originally supplied, and the relation between its amount and the body of water into which it is discharged. Under the Public Health Act of 1875 (clauses 68 and 69) a Sanitary Authority can protect any watercourse within its jurisdiction from pollution with gas or with sewage, but not from pollution by trade refuse. On the other hand, an Authority can be indicted by

[1] A Government Bill brought in in the session of 1875 had to be withdrawn in consequence of the large interests involved and in opposition to it.

landowners or others for creating a nuisance or for injuring the quality of the water by discharging sewage into a stream. In certain cases, as of the rivers Thames and Lea, special Acts restrain the pouring of sewage into them.

It may be said on the whole that legislation with respect to pollution of rivers is at present hesitating, but that its general tendency is gradually to make the rules for preserving the purity of river water more and more stringent.

[The Act of 1876 forbids putting into a stream or inland water—(1) any solid refuse of any manufactory, or any rubbish or cinders; (2) any sewage, unless the best practicable means has been taken to render it harmless; (3) any polluting liquid from any factory, unless it have been similarly made harmless. Proceedings under this Act can only be taken with the assent of the Local Government Board, who are to have regard to the industrial interests involved.]

*Conditions of Habitations.*—In the case of a town of any size, the community is represented by the municipality or by a Board of Health or local Commissioners. In the case of country parts and villages that have no such special body, the Poor Law Guardians are *de facto* the sanitary authority. In the language of the Public Health Acts of 1872 and 1875, the former are the Urban, and the latter the Rural Sanitary Authorities.

Of conditions operative upon the health of the individual and of the community, the one that falls most conspicuously within the province of these public Sanitary Authorities, as of the Legislature which created them, is the condition under which people have their dwelling—the state and circumstances of their *habitation*, both in the particular and in the aggregate. So true is this, and so strongly is this consideration felt in practice, that it will be convenient to arrange the various subject-matters of the present article with the notion of condition of habitation in the foreground; and to regard each subject as it principally concerns communities inhabiting a larger or smaller place, or as it concerns the particular habitation. Thus the general subject of public health will, with little exception, be here discussed under the three following divisions :—

I. Collections of houses forming cities and towns, that is, populations over two thousand persons.[1]

II. Villages, that is, collections of houses, with populations of, or under, two thousand persons.

III. Separate houses.

I. **Cities and Towns.**—The health of the inhabitants of English towns, as judged of by the annual rate of mortality, is not so good as that of the people of rural districts. The mean annual mortality differs in different towns from 20 or 21 to 35 and 36 per 1,000 of population, while during certain periods it may be much more. In rural districts the mortality is from 12 to 23 or 24 per 1,000. The causes of the difference are various: in towns there is greater crowding, more of complete destitution, a higher degree of impurity in the air of the houses, a greater prevalence of infectious diseases, and greater exposure in unhealthy trades. The urban inhabitants are also on the whole more intemperate, are less vigorous in frame, and have less active exercise in the open air than the rural population. In towns, however, it is especially the mortality of children under five years old which swells the death-rate, owing to the bad food and nurture, and the exposure to impure air of the children of the poor. In all cities there are districts, inhabited by wealthy people, where the mortality will bear comparison with healthy country places. It ought to be possible, therefore, to raise the health of the inhabitants generally towards the standard of these favoured parts; and the object of the local government should be, by thought and contrivance, to overcome, as far as may be, the difficulties that poverty puts in the way of health.

*Hygienic Conditions of Cities.*—These are conditions referable to :—

1. The site and soil.
2. The arrangement and building of houses.
3. The water-supply.
4. The removal of refuse water and of dry refuse.
5. The removal of excreta.
6. The conservancy of the surface.
7. The supply of food, including the regulation of slaughterhouses and bakehouses.
8. The regulation of trades.
9. The arrest of infectious diseases.
10. The disposal of the dead.
11. The supervision of nuisances.

(1) *The Site and Soil.*—The sites of old cities were fixed by reason of war or commerce, or of vicinity to water-supply; when modern cities arise it is often in consequence of new industries being developed, coal and iron, or cotton, or woollen works, and the site is determined by convenience of trade. In England new towns and villages spring up without regulation, and when they attain a certain size and some sort of municipal government is formed, it is often too late to attend to arrangement and construction of houses and to proper preparation of the ground. It were to be desired that the Legislature should obtain for towns during their period of growth and extension, adequate attention to such matters. In the case of old towns Local Improvement or Health Acts are often obtained, by which the errors of by-gone times are slowly and laboriously removed.

In respect of the *site* it is necessary to dry the ground if it is at all damp, and to keep it from being contaminated by refuse and permeation of coal-gas. It is one of the advantages of sewering towns that the ground is thereby drained, and many sewers are now laid so as to facilitate the movement of the ground water as well as to serve as channels for house waters. For this reason alone every town ought to have either a system of sewers or deep drainage of some kind. There should be no cesspits or middens, or manure heaps, in uncemented holes; every refuse of this kind ought to be removed and never allowed to soak into the ground. The

[1] There is no official definition of what constitutes a town or village, but the above is practically the best that can be adopted.

ground ought in fact to be secured against every source of contamination. Paving of all streets and courts, so as to prevent surface impurities from soaking in, and great care in the construction of the public sewers, so that they may allow of no outflow, will keep the soil of a city free from those impurities which, under the influence of heat, water, and air, generate injurious effluvia that may be sucked into houses. It is necessary also to have rules about 'made ground.' Inequalities in the surface of the ground are often levelled by filling in with refuse of all kinds; house and chemical refuse, and dredgings from rivers, with other rubbish, are sometimes used. Decomposition goes on in such soils, and eventually, if not too foul, they purify themselves, but for this time is required. In the 'cinder refuse' of Liverpool, which is tolerably free from impurities, at least three years are required for the disappearance of the more easily decomposed animal and vegetable matters. In other made soils it may be longer, and when soil is very impure, as in the case of old graveyards, it is uncertain how long it is before it would be safe to build upon it. Every made soil should be well drained, so that air and water may freely pass through it, and the best should have been laid down from two to four years before being built upon.

The permeation of coal-gas from pipes is a point to be guarded against, and the ease of preventing this would be much increased by the use of subways, the objections against which are more theoretical than practical.

With respect to the means of covering the sides of city streets for foot passengers good stone paving is essential; it not only hinders the evolution of effluvia from the ground, but it greatly increases the ease of cleaning the surface. In many Acts full powers are given for this purpose. (Public Health Act 1875, clauses 149–150, and 42.)

The question of the best kind of road for horse and carriage traffic is not quite so easily settled; there are four principal plans: macadamizing, granite blocks, wood, and asphalte. As a mere matter of health the two last are preferable; there is less *débris*, greater ease of cleaning, and less noise. Both macadamizing and granite block roads soon get worn into fine mud, which is made up of finely comminuted stone mixed with droppings from horses, and the like. In wet weather this is washed into the sewers, which it aids in obstructing, and it forms a useless part of the sewage. In dry weather it becomes pulverised; floats in the air and is one of the ingredients of city air, from which it is deposited as dust. Wood and asphalte break up much more slowly and are more easily cleaned both by rain and by washing.

(2) *The arrangement and building of houses.* The arrangement of houses and streets in towns is influenced by many circumstances. A good return for money, facility of locomotion, and beauty are the chief considerations in new towns. In old cities questions of defence and of materials have especially regulated the size and direction of their streets, and the height and compression of their houses. Many considerations will always influence the formation of streets, but a free passage of air to all parts of a town is a cardinal point, which should receive the utmost attention. The more numerous and the wider the streets are, the less impeded will be the air-flow; in no case should a street be less in width than one and a-half times the height of a house.[1]

There should be open spaces at the back of the houses, and all back-to-back building should be illegal. The erection of narrow lanes and alleys should be prohibited in all new towns, and the back courts so common in our older towns ought to be gradually removed. Additional open spaces should be provided at intervals; and streets should be so arranged as not to form stagnant wells of air between the houses. Wide straight streets are useful for ventilation, and are best for the laying of pipes and tramways. Straight lines are by some not considered beautiful, but they are certainly most convenient.

In all these points the law gave some power both in the Public Health Act of 1848 and in some later Acts, which granted permissive powers to sanitary authorities to purchase dwellings in order to improve streets, to set back houses when rebuilt, &c. These powers are continued in the Public Health Act of 1875, clauses 149–160. As regards existing towns power is given to urban authorities to make bye-laws regulating the width of new streets, provision for sewerage, foundation of houses, spaces for air about houses, the drainage of buildings, and other points. So also a new provision in this Act orders that when only the front of a house in a street is taken down the urban authority may prescribe the line of the new building. Local Improvement Acts have also been obtained by some cities, giving larger powers of demolition and reconstruction, and the Artisans' Dwellings Act of 1875 strengthens these. As much, however, is left to local authorities in these matters, there will probably be no uniformity of action, and it seems important to make very stringent general rules on all these points. Moreover, as already said, due provision should be made beforehand for the proper construction of the many new towns which must needs spring up in the course of another century. The case seems clear for the community at large to regulate matters so important for the general health, to a greater degree than has been yet done in any Act.[2]

It is not possible to state with any precision the number of persons who may be located on an acre. This will depend in the main on the construction of the individual houses; but it may be laid down as a general rule that whatever be the size of the houses, the amount of ground not occupied by them in any given area should be con-

[1] In some local Acts the width of a street is fixed at the height of a house, but this is too small.

[2] As an instance of the necessity of this state interference, the case of Liverpool may be cited. More than 70 years ago the Corporation was warned by the medical practitioners of Liverpool, that the houses then being erected, and their arrangement, must prove unhealthy dwellings. No regard was paid to this, and now Liverpool will have to undo, at enormous cost, what might at the time have been put a stop to with ease. A paper by Dr. Russell, of Glasgow, in *Public Health*, March 1875, exemplifies the same thing in a most striking manner, by the case of Glasgow.

siderably in excess of the amount actually taken up by houses.

An important point to determine is the height of the houses. In England a large proportion of our towns consists of low brick houses; if these are not too crowded they give a good distribution of the inhabitants and oppose little obstacle to the movement of air. When the houses are very lofty the air-currents must be much more impeded, and therefore the streets ought to be much wider, and open spaces here and there more carefully provided. The construction of the separate houses cannot be altogether a matter of municipal control, but certain rules as to ground plan, foundations, and arrangement of closets, and the thickness of party walls, are in most towns enforced in respect of new houses.

So in all houses, whether urban or rural, there should be means of ventilation for every room; no inhabited room should have a borrowed light, but should have a window opening directly on the external air; every window should open, and especially at the top; every room should be of good height, not less than nine feet in the smallest, and ten and eleven feet in larger rooms; the closets ought to be arranged in such a manner that, in addition to ventilation of the closet itself, there should be thorough cross ventilation into the open air between the closet and the rest of the house, and this is best accomplished by having projecting portions of the building to contain the closets; every house should be properly provided with closets in proportion to its population; there should be proper water-supply, with easily inspected storage, if house-storage is permitted, and easy methods of carrying off the dirty house-water; there should be proper arrangements for the collection and temporary storage of dry house refuse; and house drains and pipes should be constructed and ventilated on the principles that will presently be set forth.

All these matters are easy to regulate without interfering too much with the plans of the architect, and have, in fact, been more or less dealt with in several Acts. In places with urban powers, indeed, bye-laws under the Public Health Act can be made to regulate the majority of such points.

(3) *The Water-supply.* In a town with sewers and water-closets it is generally considered that the supply of water per head daily should not be less than 25 gallons; and if there are trades using large quantities of water, from five to ten gallons additional (reckoned per head of population) are wanted for the town. If there are no water-closets, from 14 to 20 gallons per head daily appears to be the amount usually considered sufficient in large English towns.

Many Acts, public and local, regulate water-supply. The sanitary Authorities of any place have had large permissive powers (under previous Acts, and now under the Public Health Act of 1875, clauses 51–67) as to constructing, or buying and maintaining waterworks, and building and cleansing public cisterns, fountains, &c., and powers are given also to protect watercourses or watersheds whence the supply is derived. The Public Health Act of 1875 has also increased, in some ways, the powers of the local authority, and in certain cases the powers of the Public Health (Water) Act of 1878 can be exercised in towns. In local Acts powers are also given to ensure proper fittings in houses, to carry out constant service, and other points of the kind.

The following are the matters of chief importance in towns:—(*a*) The supply should be taken from sources capable of affording a quantity adequate to the present and proximate wants of the town, with such approach to constancy as may be attainable. In quality,[1] the great points are to ensure that the water is clear or is easily and completely freed from sediment by sand-filtration, and is well aërated, pleasant to taste, and without smell; that it contains no injurious animal constituents, and cannot become contaminated with excreta of men or animals, or with foul water from houses; that it contains no injurious amount of vegetable matter (not more than 2 or 3 grains per gallon) and that its mineral constituents are of moderate amount, not exceeding 60 grains per gallon as a maximum, and consisting of such mineral matters as are not likely to be injurious. With respect to lime especially, much discussion has taken place as to whether soft or hard water (from calcium carbonate) is best for a town; the soft water is preferred for many trades and is probably best for health, though it has been found impossible to prove this by statistics; it is certain that the inhabitants of numerous towns using a good chalk water have excellent health, and it would seem in fact that the question between water hard from calcium carbonate and soft water is not an important one. When water is hard from calcium chloride and sulphate it seems more injurious to health. The great point in choosing water is, in practice, its freedom from any chance of contamination with excreta, or with refuse matter from habitations.

The sources of supply are natural lakes, artificial lakes and gathering grounds, rivers, springs, and wells.

In towns of any size superficial and shallow wells are always suspicious sources, as it is impossible to secure them from foul overflows and soakages. Clause 70 of the Public Health Act 1875 gives power to close wells, tanks, cisterns, or pumps if the water be polluted.

The duties of a medical officer of health should include the supervision of the sources of supply, so as to detect and prevent any possible contamination.

(*b*) The water when supplied, except in the case of deep well waters, most commonly needs to be stored and filtered. The reservoirs of our towns contain from one to three months' supply, or less if the supply is very constant. The reservoirs require to be well placed; to be clear of trees, and protected from danger of anything being thrown into them. The filters are usually made of sand about 3 feet in depth, and the water is passed through at the rate of from ½ to 1 gallon

[1] Section 55 of the Public Health Act, 1875, imposes on the Local Sanitary Authority the obligation of keeping the supply of water pure and wholesome in the case of waterworks which have been purchased or constructed by them.

to every square inch of surface in 24 hours. The upper sand of the filters requires frequent cleaning, and should be regularly inspected. This plan acts well, but constant supervision is necessary.

(*c*) After filtration the water is distributed by means of pipes, usually by iron pipes, tarred or concreted inside, for the larger conduits, and then by lead pipes, or what is better, tinned-lead pipes for the smaller. Both iron and lead, and especially the latter, are dissolved by some waters, and the question whether lead is so dissolved has often to be answered; in examining into this matter the water should be taken after it has been in contact with the pipes for some hours. Carried down by these pipes the water is either delivered at intervals to house cisterns, or, what is far better, is supplied on the constant plan without house-storage. If it be not possible to dispense with house-cisterns, they should be well made of slate or concrete, should be able to be easily inspected and cleaned, and their overflow pipes should always end in the open air, never go into any sewer. The greatest care should be taken that the cistern water shall run no risk of contamination by absorption of foul air or by soakage into the cistern, which should be well covered to prevent dust getting in.

If the constant system is in force it should be truly constant, for if the water is cut off at intervals, and the house-pipes are then emptied, air must be drawn into them and this air may be foul; it has even happened that dirty liquids have been sucked into water pipes, as where a closet service-pipe has dipped into a choked closet-pan, and in this way excreta have not only passed into these house-pipes but have even got into the mains. Under a constant system and under an intermitting system alike, small service-cisterns are needed for water-closets and for kitchen-boilers, and precautions have to be taken with these cisterns equally with larger storage-cisterns. In fact too great care cannot be taken in thoroughly guarding water-pipes and cisterns in every way. The dangers connected both with the intermittent and constant systems have only been fully recognised during the last few years.

The sources of contamination of drinking water are very numerous, and may affect the water at its source, in its flow, in the reservoir, or during distribution. If stored in houses it is especially exposed to risk; and this is the grand argument for constant service, that the water may be delivered immediately after filtration. The plan of cistern-storage, indeed, lessens those risks that are incidental to intermissions; but this plan demands that cisterns be properly made and placed, and be regularly cleaned. For low-rented houses these conditions are very difficult of attainment, and therefore the constant service is peculiarly adapted to the houses of the poor. Siphon-filters of animal charcoal placed in cisterns, filter the water immediately before use, and are much to be recommended.

In all towns the service should be at high pressure, so that water may be carried to every floor and thus labour be spared, and the freshness of the water be secured. In towns where the water is not carried into the houses, but is fetched from 'hydrants' or stand pipes in the street, it has to be stored in the houses in buckets and runs many chances of impurity.

A town requires water for public purposes, such as for public baths, washhouses, flooding and washing streets, flushing sewers, and putting out fires. Statutory powers are given for carrying out these objects.

(4) *The disposal of dirty house-water and dry refuse.*—After being distributed and used in houses or trades, the water with the impurities it has gathered must be carried out of the town. The inhabitants should have no difficulty in getting rid of their dirty water, or the same water will come to be used several times for cooking and for washing. Houses ought to have convenient sinks discharging by trapped pipes opening outside the house, not into a drain, but over a drain-grating. From hence it must go along pipes or sewers, and be disposed of at the outfall in some way. House-water, besides other impurities, invariably contains some portion of urine. It is not fit to be at once discharged into streams, but as its fertilising powers are small it is not well adapted for irrigation or precipitation. The best plan appears to be to filter it by intermittent filtration on a small area of properly prepared and drained ground, and then to carry it into the nearest stream.

The dry refuse of houses consists of cinders and ashes, remains of food, dust from sweepings, and various other used-up articles of house life. In some towns there is little difficulty in disposing of this refuse. After being carted away it is sorted, and every article finds a sale. In other towns, however, the disposal of the house-refuse is a matter of difficulty and expense. In some places the dry refuse is placed every day by the inhabitants in front of the houses and is removed by scavengers. In other cases there is storage of refuse on the premises; if this is done every house should have a properly prepared dust-bin, well-paved to prevent soakage, well-covered so as to be kept dry, and so placed as to be convenient for the house as well as for the town-scavengers. In the building of any house the arrangements for the position of the dust-bin are almost as important as those for the closets. The removal ought to be frequent and regular, but the frequency has to be fixed by special circumstances.

(5) *The removal of excreta.*—The excreta of the skin and lungs are got rid of by ventilation and washing, so that this heading refers only to the solid and liquid excreta. These average respectively (for both sexes and all ages) about 2½ ounces avoirdupois of solid excrement and 40 fluid ounces of urine *per diem*.

The excreta ought not to soak into the earth, or to remain near dwellings. The common privy and the 'midden' of northern towns cannot be brought to fulfil these conditions. In towns above 10,000 inhabitants it now seems clear that there is no possibility of using the earth or any deodorising plan, on account of the expense of transport. Therefore, for towns, two

or perhaps three plans only remain: 1. The dry plan with frequent removal, with perhaps such deodorisation as the ashes of the house may give —this is the so-called 'pail system' in some one of its forms. 2. The water system, the excreta being carried off from the house along drains and sewers, by the aid of water. 3. The air or pneumatic system of Captain Liernur, in which the excreta, unmixed with water, are sucked through pipes into a central reservoir by an air-pump, worked by a steam-engine. This plan of removal is as yet unfamiliar. It is now being fully tried on the Continent, and in after years there will be reliable data as to cost for original plant and for maintenance, as to certainty and efficiency of working, and as to returns from sale, all of which are now matters of doubt.

It would not be possible to discuss here the relative value and the technical details of the pail and the water systems. Both are largely used in England. The former is used in towns where the barbarous cesspit and midden plans are abolished, and yet where proper sewers cannot be made, or water is deficient, or land cannot be obtained for irrigation or filtration; it has the disadvantage of keeping the excreta for some days near the house, and is sometimes attended with nuisances in the working, but, on the whole, it is capable of keeping a town clean when it is properly carried out, and it is an immense advance over the old midden system, which retained the excreta for long periods in the very midst of the people. It is, however, essential that the removal of the excreta should be frequent, that is, once a week or so—twice a week if practicable. After removal the excreta are applied at once to the land, or are made into poudrette. In some towns the house-ashes are thrown on a wire screen, so as to allow the fine ash to fall on the excreta—this is sometimes called the 'ash plan;' in other cases deodorants are used. The 'Goux system' is to place some absorbent material round the interior of the pail to absorb the urine.

The water system is more complicated, and probably more expensive, but if properly carried out is more effectual. If a town can make good sewers, and has water for flushing and land through which the sewer water can be passed by filtration or irrigation or both, the water system is the best for health.

It is essential, however, that sewers should be well constructed, and should allow no deposit, and that they should be thoroughly ventilated. Deposits are prevented by having egg-shaped sewers with a proper fall, easy means of access for inspection and cleaning, and a regular flow of water with periodical flushing. The ventilation of sewers, which is now enforced by law (clause 19, Public Health Act, 1875), is best effected by having numerous openings—as many, in fact, as can be made—so as to allow constant and free interchange between the sewer air and the atmosphere. These openings may be by street-gratings or by special shafts, according to circumstances. Ventilation through furnace chimneys can be sometimes done, but is of no avail for distant portions of the sewers. The openings may, at certain points where the shafts or gratings are near houses, have to be guarded by trays of charcoal, through which the sewer air passes. But in whatever way it is done, the rule must be to have the freest communication between the sewer air and the general atmosphere. This free ventilation occasions no offence if the sewers are properly made and kept; while, if the air of sewers at the ventilators is found offensive, the ventilation will at least have provided against the more dangerous discharge of the foul air into houses. As a further provision against possible reflux or suction of the air of the public sewers into houses the following arrangement should be rendered imperative by law. At some point in the course of every house-drain, before it reaches the main sewer, there should be complete disconnection by means of (*a*) a 'siphon-trap,' through which all the liquids of the house must pass, and which, therefore, must always be charged with water while the house is inhabited; and of (*b*) an opening from the house-drain to the outside air, made on the house side of the siphon-trap, to provide for the escape of any sewer-air that may force the trap, as well as for the ventilation of the house-drain proper. If this were done the spreading of disease by town sewers would be impossible, and the greatest objection to them would be removed. The community constructs the main sewers, but it would seem just that the owners of house property, who provide the house-drains and are obliged by law to connect them with the public sewer, should be compelled to put down one of the open-air traps, which renders reflux impossible into their houses.

Sewers have been objected to on account of the occasional spread of typhoid fever and diarrhœal affections, and perhaps of cholera and diphtheria by their agency; but, if properly arranged, and with disconnection between the sewer and houses, there would be no danger; and it is difficult in any case to see how sewers can be displaced or be substituted by any other plan. The house-water must be carried off, and it is impure even if no excreta are allowed to flow in. Even if the pail or pneumatic plan be adopted, there must still be town sewers for dirty house-water, and all the precautions above alluded to must be enforced. Sewers, then, whether or not they receive the excreta of a town, are a necessity, and with proper construction and management, they certainly ought to be solely beneficial to the public health. It is certain that when a town is well sewered the prevalence of enteric fever is lessened even to the point of extinction, and diarrhœal affections have appeared to be more uncommon. Drying of the soil by sewers also lessens phthisis. It is a question of engineering detail whether the sewers carrying the house-water should also carry off the rain water. In some cases the 'separate system' (that is, having different channels for house and rain water) appears clearly the best. The sewer water is less in amount, more regular in flow from day to day, and richer in fertilizing properties.

With regard to the disposal of the sewer water, three plans can be followed in the case of towns which cannot discharge at once into the sea or (without disobeying the Rivers Pollution Prevention Act of 1876) into a large river: first, precipitation at the outfall with a chemical agent such as

lime, aluminous compounds, phosphate of lime and alumina, clay, &c. A great number of chemical agents have been proposed, and several clarify the water fairly, but none yield a deposit which pays the expenses either as manure or when burnt into cement. Precipitation must, however, be had recourse to when land cannot be obtained. Second, irrigation, one acre being sufficient for the excreta of about one hundred persons. Third, intermittent filtration, where one acre is sufficient for from 2,000 to 3,000 persons; the land receives water six hours out of the twenty-four, and is deeply drained. In neither extended irrigation nor in filtration on a limited area is there any adequate profit, but still there appears to be some, and the purification is more complete than by precipitation. In some cases after filtration the water is passed over farm land, and this double purification appears to be very satisfactory.

It appears certain that neither irrigation sewage farms nor filter-beds are hurtful to the public health when properly managed.

(6) *The conservancy of the surface area.*—The cleansing of the surface area of towns is secured partly by powers originally given in a variety of Sanitary Acts, general and local, and continued with additions in the Public Health Act of 1875, clauses 42–50. These powers are large and on the whole sufficient. The sanitary importance of thorough surface-cleansing is obvious; the mud and dirt of towns and refuse of all kinds, wetted by rain and exposed to heat, soon decompose and give out injurious effluvia, especially in narrow courts and lanes where the movement of air is impeded. The excellent effect on health of paving a town has been often observed. Public streets of all kinds can be easily kept clean, but want of paving and consequent foulness on private premises require to be sought out. Under the above and other clauses in the Act the supervision of pigsties and stables is carried out and, generally, conditions which can give rise to nuisances injurious to health can be legally dealt with.

(7) *The Supply of Food, including the Regulation of Slaughter-, Cow-, and Bake-houses.*—A very important duty of a municipality is to supervise the food of the people. While the price and quality must be left to the ordinary operations of commerce, the responsibility of preventing falsifications, and of ensuring that the article shall not be injurious to health, must rest on the sanitary authority. The regulation of slaughter-houses and knackers'-yards, directed by former Acts, is authorised afresh by the Public Health Act of 1875, **clauses 166 to 170.** Private *slaughter-houses* are licensed, and can be visited and subjected to bye-laws. They are often constructed out of buildings intended for other purposes, are not fitted with proper appliances, and are generally placed in the densest part of the town. The evils attending them are gradually being removed by the erection of public slaughter-houses, where abundant air, water, good sewers and means of cleansing are provided. The custom of slaughtering in the country and then sending the meat to cities is increasing and this again renders private slaughter-houses less necessary.

The transport of cattle and sheep to towns is a matter of very great importance as respects both the goodness of the meat and the comfort of the animals. It is a matter which should be dealt with in the Public Health Act, and should be under control to a certain point. Space in the trucks, supply of water and food, length of journeys, and other matters, require regulation.

*Cowhouses* are usually inspected by sanitary authorities, in pursuance of the powers of the Public Health Act, §§ 91–92, or of private Acts. In the metropolis they have to be licensed by magistrates. A certain cubic space is usually allowed to each cow (1,000 cubic feet should be the minimum), and cleanliness is enforced. The condition of small cowhouses and dairies, and of the water-supply and drains attached to them, requires more attention than it has received, as both enteric and scarlet fever are now known to have been spread by the agency of milk.

[To these diseases must now be added diphtheria; and the suggestion that diseases of the animals themselves, as well as impurities received from water or air into their milk, are concerned in the production of milk-epidemics among human communities, will henceforth always have to be kept in view.

The foregoing requirement has been in a measure fulfilled by the Contagious Diseases (Animals) Act of 1878, which requires cowhouses to be licensed, and their sanitary condition attended to; and requires precautions to be taken in dairies and milkshops against the contamination or infection of milk. An Order of Council has been made respecting these various matters. It is observable that sanitary authorities are not charged with the duty of inspection under this Act, except in the case of corporate towns.]

*Bakehouses* are regulated under a special Act (26 and 27 Vict., c. 40) which was passed after long enquiry into the condition of the trade. By this Act the bakehouse is ordered to be kept in a cleanly condition, to be properly ventilated, protected from effluvia, and not to be used as a sleeping-place. The condition of the bakehouses disclosed by the enquiry referred to, was in the highest degree disgraceful and repugnant.

The inspection of the chief *articles of food* takes place under the Public Health Act of 1875, clauses 116 to 119, in respect of meat, game, poultry, fish, fruit, vegetables, corn, bread, flour, and milk, and under the Adulteration and Licensing Acts in respect to other articles of food.

The following are the chief sanitary points in each case:—

1. *Meat.*—Much doubt exists as to the extent to which the condemnation of meat exposed to sale should be carried. There is no doubt that meat sufficiently decomposed to be discoloured and to have a putrid smell, and meat with abscesses and suppurations, should be condemned, but the difficulty arises with meat apparently sound or not very obviously otherwise, but which is derived from diseased animals.

Though opinions differ on this point, it may perhaps be said that meat derived from animals dead of inflammatory diseases and of epidemic

pleuro-pneumonia may be used, but that beef from cattle dead of cattle-plague and anthrax (malignant pustule), mutton from sheep with small-pox and splenic apoplexy, and pork from pigs with carbuncular diseases, hog-cholera, hog-typhus, and scarlet-fever, should not be used, although it is not easy to give conclusive evidence as to bad effect in some of these cases. Cattle-plague meat, for example, has been largely used without injury. Opinions are much divided as to whether the flesh of braxy sheep, or of cattle dead of foot-and-mouth disease, should be used or not, but at present the evidence is rather against the view that such flesh is injurious.

In the case of the parasitic diseases of animals the question is easier. It is of course highly dangerous to use pork with trichina. [Some recent experiences are pointing to trichinosis as a more common disease than had been suspected.] Cysticerci in pork, beef, and mutton should also, in the writer's opinion, be a valid ground for not permitting the sale, though this view is not universally or perhaps generally held, since as cysticerci are killed by a temperature of 160° Fahr., it is considered that good cooking removes all danger, and therefore that condemning meat for this cause is an improper restriction on supply. On the other hand, as it is impossible to secure that a sufficient temperature shall be applied, how can it be possible to prevent the development of tape-worm if the sale is permitted? The prohibition would probably not long affect supply, as the breeders and salesmen would take greater care in preserving the cattle from parasitic infection; and that this can be done, by supplying pure water and clean food, is shown by the experience of Upper India.

Flukes in the liver do not constitute a valid ground of rejection of the meat, though the liver ought not to be eaten.

Some very remarkable examples of an acute specific disease of peculiar characters have recently been observed among consumers of meats derived from the pig; where the sole evidence of disease in the meat has been the presence of a cultivable bacillus. *See* Poisonous Food.

Sausages when musty and strong-smelling should be rejected, but, owing to the spices used, decomposition is not easily made out. The peculiar 'sausage-poison' has not been identified.

*Wheat-Flour and Bread.*—The chief points are to ascertain that there is no ergot, no fungi, nor acari; that alum has not been used; and that other grains or mineral matter are not mixed with it.

Under the Adulteration Act the following, among other articles, may have to be examined: *Milk*, the chief falsifications in which are addition of water or removal of cream. Falsification in other ways is not common. It may also be improper for use, owing to the presence of blood, lacteal casts, pus and fungi. *Butter*: the falsifications here are admixture with foreign fats, and excess of water or of salt. *Cheese*, which may be decomposed, mouldy, or have copper added to preserve it. *Coffee*, which may be putrid or decomposing, or mixed with chicory, roasted corn, &c. *Tea*, which may be decomposed, mixed with exhausted leaves, or with leaves of other than tea-plants, or with sand, iron ore, colouring matters or facings. *Cocoa*, to which various starches may have been added, or the fat exhausted. *Oatmeal*, to which inferior barley or wheat- or maize-flour may have been added. *Maranta arrowroots*, to which potato starch or inferior kinds of arrowroot may have been added. *Spirits*, *wine*, and *beer*, in which there may have been addition or subtraction of spirit; improper spirits, as methyl or other alcohols, added; addition of water, salt, sulphuric acid, ferrous sulphate, lime-salts, lead, cocculus indicus, hot spices, aloes, quassia, burnt sugar, &c.[1] *Vinegar*, the chief falsifications in which are the addition of water and occasionally of sulphuric acid in excess of that permitted by law ($\frac{1}{1000}$ part.)

In no case is an examination of food under the Adulteration or Licensing Act made to determine the quality of a pure food; it is directed simply to detect the presence and amount of foreign-substances, or of decomposition and putrefaction. The law permits mixtures to be sold in some cases, if the admixture is stated on a label.

(8) *The Regulation of Trades.*—Trades are affected by the law under two points of view: 1st, irrespective of the nature of the trade, the *place where it is carried on* is regulated under the Mines, Factories, and Workshops' Acts; and by the Public Health Act of 1875, urban authorities can make byelaws regulating offensive trades, such as blood and bone boilers, fellmongers, soap, tallow, and tripe boilers, &c. The object of the Factories and Workshops' Acts, among other things (such as restriction of labour at certain ages), is to provide that the common conditions of health are not violated. This is a very necessary point, for many workshops are deficient in light and air, are badly ventilated, or are rendered unhealthy by gas burnt for light. Many small workshops are owned by men of small capital, who often sacrifice the health of workmen by compelling them to work under very unfavourable conditions. Happily the faults are usually easily remedied by a little common sense and simple appliances, and in this respect the Workshops and Factories Acts have done great good. One special fault in many workshops is, however, still common, namely, the burning of gas in large quantities in dark shops, without proper means of carrying off the products; the very great influence of this condition on the lungs was long ago pointed out by Dr. Guy.

2. The other point in the regulation of trades is to prevent any of the *processes being nuisances* or injurious to the health, either of the work-people or the inhabitants of the surrounding districts. This is an extremely wide subject. Trades may annoy and inconvenience the public, as by offensive effluvia, black smoke, or acid vapour which destroys vegetation, yet may not be distinctly injurious to health. On the other hand, without being notable nuisances in the above sense, they may be hurtful to health, especially those (and they are very numerous) which give rise to dust in the air of any kind. Cotton and

[1] The examination of adulteration of beer is now so far more difficult as the law allows other bitters besides hops to be used, and it is understood there are numerous cheap bitters now used in place of hops. It is very desirable that the old law allowing only malt and hops to be used in the making of beer should be re-enacted.

woollen *débris*, metallic vapours, filings and grindings, particles of size, clay, dry paints, and many other substances, come under this head. Much debate has taken place as to whether certain gases, such as carbonic acid, chlorine, iodine, sulphuretted hydrogen, sulphurous acid, or the fœtid vapours given off from catgut, gelatine, manure and other trades, are or are not injurious to the health of the workmen, or persons living near the factories. In many cases the discussion is not closed, and fuller enquiries are necessary; but at present it seems as if these gases and fœtid effluvia, in such proportions as they are met with about factories, are not proved to be unhealthy (though their innocuousness cannot be asserted), however disagreeable they may be; whereas there is no doubt that the inhalation of all solid particles, no matter whence derived, is highly injurious. Phosphoretted fumes escaping into the air have affected the jaw-bones of persons exposed to them; this happens now much less than formerly.

The spread of *infection by trade operations*, as of anthrax among woolsorters, and of smallpox among paper-makers, has recently come to demand recognition.

There is one article, the use of which gives rise directly and indirectly to a large amount of sickness, and the trade in which certainly requires regulation, if the public health is to be regarded. This is *alcohol* in its various forms. Owing to peculiar social customs, to the insufficient recognition of the immense amount of harm produced by excess of alcohol, and to a want of definition of what is excess, the laws of this country have not only legalized the sale of a dangerous article of diet, but have actually encouraged the sale, until an evil so gigantic has been produced that no one has yet suggested a reasonable remedy. Yet the sale of alcohol is so distinctly a source of disease and of injury to the State, that it must be considered by those who have charge of the Public Health, and in some way must eventually be restricted. One source of the error seems to be that alcohol is regarded by the State, not only as a source of revenue, but as an indispensable article of refreshment. There is, of course, no question that the public must be supplied with houses where they can obtain proper refreshments, such as meat, bread, vegetables, milk, coffee, tea, or other articles of the kind; and 'public-houses' were intended to supply articles of this description as well as the alcoholic liquids which enter into the ordinary diet of most people. Yet, unfortunately, a system has grown up by which our public-houses have become only places where alcoholic liquors are sold, and this is defended on the ground that such liquids are refreshments. The amount of temptation which has been put in the way of our working classes by the heedless multiplication of these grog-shops during the last forty years accounts for much of the drunkenness which so deeply affects our national life, and injures the health of the people. A remedy ought and must be found for this state of things, or else sanitary legislation will still present the absurd spectacle of raising up with one hand what it is smiting down with the other.

(9) *The arrest of the Contagious and Infectious Diseases.*— Small-pox, scarlet fever, measles, hooping-cough, diphtheria, enteric fever, typhus, and relapsing fever have to be dealt with. Among other contagious diseases also syphilis and gonorrhœa must be included.

Of late years, since the recognition of the fact that each of these diseases must have its own special cause, the prevention of the infectious diseases has become much easier, although the exact nature of the cause may be unknown. The general principles on which the prevention is based are—1. The recognition of the places of origin and conditions of formation of the morbid agent, that is, whether it arises from processes going on in some of the structures of the human body, or in substances outside and independent of the body, with further question as to the nature of these substances, structures, or processes; when these points are known, it is to be expected that the formation of the agent can be prevented or the agent can be destroyed. 2. The recognition of the means of spread of the agent, after its first formation, that is, whether it spreads by the help of the air, or is carried in drinking water, or in food, or is transferred directly from one person to another; so that when known the carriage of the agent may be stopped. 3. The early removal of the person affected from among the community, so that the risk of spreading in any way may be lessened.

In the case of each of these diseases the preventive measures are different, and it is impossible here to go into so large a subject as the prevention in each case. The measures include a continual supervision over the conditions of origin, introduction, and spread as far as they are known.

Two points must, however, be specially noted. The isolation of persons ill with any disease which directly or indirectly can spread from one person to another is a necessary step in all cases. In the crowded houses of towns some diseases such as typhus, scarlet fever, measles, relapsing fever, &c., spread with great rapidity, and the only possible check is to remove the sick at the earliest moment from the houses, and to prevent persons ill with infectious diseases from exposing themselves in public places and conveyances.

For the first purpose sanitary authorities have powers (Public Health Act 1875, clauses 120 to 140) to remove persons ill with infectious diseases to a proper hospital in special conveyances; to prevent sick persons frequenting public places or conveyances; to destroy bedding or clothing, and to disinfect rooms, houses, or clothing. Hospitals for infectious diseases can also be built, and are now being constructed in many towns; it is desirable to make them simple, cheap buildings of wood or iron, able to be thoroughly cleaned, or after a term of years to be destroyed and replaced. These hospitals should provide a cubic space of from 1,500 to 2,000 cubic feet with a floor space of from 120 to 140 feet for each patient, and efficient separation between patients suffering from one and another infectious disorder. The freest ventilation, supply of water, and means of disinfection are essential. Under the same Act a town is empowered to erect a proper place for disinfecting

clothing and bedding; and disinfecting chambers (heated by hot air, steam pipes, or gas, and in which a heat of 240° Fahr. can be reached) are now provided in many towns for the immediate disinfection by heat of all soiled clothes taken from patients with any of these diseases.

The disinfection of the excreta or of discharges from the body, or of the air surrounding sick persons, is also attempted and is evidently a proper plan to follow, though the results are at present uncertain. The spread of scarlet fever, however, appears to be arrested by rubbing the skin with carbolized or camphorated oil; typhoid fever is probably stopped by strong chemicals added to the intestinal discharge; and the spread of typhus has been also lessened and perhaps arrested by aërial purifiers, especially nitrous acid fumes.

Small-pox is prevented by vaccination, and for this there are special Acts and a special organization.

The prevention of syphilis and gonorrhœa by periodical inspection of prostitutes, and removal of them to lock hospitals when diseased, is only carried out in this country in certain military and naval stations, where the effect has been to lessen primary syphilis by nearly one-half, and to abate its virulence. The effects of the Contagious Diseases Acts upon the women, in respect not only of curing them but of influencing them for good and of reclaiming them, has been very remarkable. In Germany, France, and Belgium precautions against venereal diseases have been carried out among the entire population for many years, with the effect of greatly lessening the amount and virulence of syphilis.

As syphilis has a most pernicious effect upon the health of a very large number of persons, it is most urgently to be hoped that the Legislature may before long deal thoroughly with this matter and attempt to lessen syphilis, not merely in the army and navy, but among the population at large.

(10) *The disposal of the Dead.*—Two points are involved in the disposal of the dead both in towns and villages.

1. In this country where so many families live in single rooms, and where the custom of keeping the dead five or even six days before burial is usual, it constantly happens that a corpse is kept for days in the room where all the family life is carried on. As decomposition, especially in some diseases, commences early, it cannot be doubted that an unfavourable effect on health must be often produced. To avoid this detention, mortuary chapels ought to be constructed in all towns and villages, and to these all corpses should be removed from the houses of the poor within thirty-six hours after death.

Power has long been given (Public Health Act of 1848) to the Sanitary Authority to provide mortuaries, and the Act of 1866 gave power to remove, when necessary, corpses from rooms where persons live and sleep. These powers are continued in the Public Health Act of 1875, and clause 141 also now imposes on the local authorities the duty of providing mortuaries, if required by the Local Government Board to do so. Very little has as yet been done in this way, and England is in this respect far behind some of the Continental States.

2. The second point is the disposal of the corpse. The law of England now allows no burial-grounds in large cities, nor burial under churches, and consequently cemeteries are provided at convenient distances from towns. These cemeteries ought to have a dry soil, so that the ground water shall never rise high enough to wet the corpse or to float it up in the vault, as sometimes happens; they should be as far from houses as practicable, and the minimum limit of 100 feet allowed by Government is much too little; there should be good drainage, and the water should not run into any well or water-course from which drinking-water is taken; the site should be well ventilated and well planted, so that the roots of plants may absorb the decomposing matters. The kind of soil will, of course, depend on the locality; in many cases there is no choice, but if there be a choice a marly soil, not too stiff, but allowing free permeation by air and free flow of water, should be chosen; gravelly soils act pretty well, but are said to form a compact mass round the body, which prevents access of air and moisture; the lime and chalk soils act better, and especially if the soil is alkaline; very stiff clay preserves bodies longer than less compact soils.

Bodies decay in very various times, according to soil, access of air, amount of pressure, &c. In some cases a corpse may be destroyed in three years; but when ground has to be used over again, a period of from five to thirty years is allowed in different countries before the second use. Bodies should be buried deeply (4 to 6 feet) in order to lessen the chance of contamination of the air, though it is supposed that when the graves are shallower, decomposition is more rapid; the graves should not be bricked, but the earth allowed to rest on the coffin.

It has been proposed to use not coffins, but sheets or wicker-baskets, so as to let the earth at once come in contact with the body; and, in fact, in many villages in England it was formerly the custom to carry the corpse in a coffin to the churchyard, but then to remove it from the coffin and place it in the ground in a sheet. If the coffin is not made too strongly it is probable that it does not much delay decomposition; so that this point does not seem very material.

The decomposition of bodies occurs by putrefaction, with rapid disengagement of effluvia; or by a sort of insensible decomposition, the products being decomposed as rapidly as they are formed by the earth. In other instances the decomposition is by saponification. This last condition is said especially to occur if the earth is too closely pressed on the body, and gets too saturated with the products of putrefaction.

As in some cases conveniently-situated and proper land cannot be obtained, a discussion has lately arisen whether burning, or, in the case of seaboard towns, burying the body in the sea, might not supersede burial in the ground. This article, however, is not the place to enter into this question.

(11) *The Supervision of Nuisances.*—[Nuisances

are defined in the Public Health Act, § 91, as being—(1) any premises, (2) any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain or ashpit, (3) any animal, (4) any accumulation or deposit, (5) any over-crowded house, or part of a house—that are 'a nuisance or injurious to health.' These words, as they occur here, must be read with reference to the general purposes of the Act, and will therefore include only things or conditions as above that are of a nature to injure health: mere disagreeableness or annoyance, though it may be a 'nuisance' at common law, not being enough to constitute a nuisance in the above cases. Moreover, (6) dirty or unventilated factories and work-places, or any that are unnecessarily dusty, and (7) manufacturing furnaces and the like that do not consume their own smoke, are, in this Act, included with nuisances under certain limitations.

It is the duty of every Sanitary Authority to cause inspection to be made of their district to discover nuisances; and a certain procedure for the abatement of nuisances, and for the prevention of their recurrence, is appointed by the Public Health Act. For the performance of these functions the Authority is required to appoint one or more Inspectors of Nuisances, to whose office certain powers are attached. [The work of nuisance-inspection, in its every-day concern with conditions injurious to health, cannot be properly performed without the constant and intimate relation of the Medical Officer of Health with the Inspector; and those districts are unquestionably best served as to sanitary inspection where the Authority has devolved on the Medical Officer the duty of instructing the Inspector and of supervising his work.]

II. **Villages.**—Although many of the earlier sanitary enactments had application to villages, it was not until the passing of the Public Health or Sanitary Act of 1872 (35 and 36 Vict., c. 79) that rural sanitary authorities were constituted. These authorities, namely, the Guardians of rural Poor Law Unions, can now exercise considerable powers, and if properly set in action by their medical health officers and inspectors of nuisances (whom the authorities are obliged to appoint), a great effect must be gradually produced upon the rural labouring-class, whose condition has up to this time been almost entirely neglected. As the urban authority in towns, so the rural sanitary authority in country places may provide water for public use, may make public cisterns or baths, may protect watercourses, may construct sewers and dispose of sewage matter; must take care that no closet or privy is a nuisance; may clean ditches and remove refuse, and may make regulations as to cellar-habitations and common lodging-houses. [Much increased power of securing proper water-supply in the particular house within rural districts has been recently given by the Public Health (Water) Act of 1878.] All powers possessed by urban authorities as to trades, sale of unwholesome food, removal of nuisances, providing mortuaries and hospitals for infectious diseases, are now also possessed by the Poor Law Unions (Public Health Act 1875, clauses 5 and 9).

At present, however, except in those places where several rural sanitary authorities have united to appoint a first-class sanitary officer, little has been done in English villages.

The problem is, in fact, by no means an easy one, but it is being vigorously discussed, and will be no doubt eventually solved by the officers of health of large areas, many of whom are men of great knowledge and distinction. The difficulty arises from the houses in the rural districts being, in a great number of cases, old, dilapidated, unsuited for dwellings, and destitute of proper conveniences. When new houses are built, the sanitary authority can enforce certain provisions, though it has far less control over building operations than is possessed by urban authorities. In the case of houses already built, however, its power is, from circumstances, even more limited. There is very little money available for improvements; the poor-rates are already often heavy, and guardians hesitate to increase them. The small number of houses in villages also, in comparison with the outlay needful to supply sewers and water, renders the cost per head relatively much greater than in towns. Progress, therefore, in rural districts must be slow, but yet it cannot be doubted that the present condition will be gradually improved. In addition to bad construction and dampness of houses, the most frequent sanitary defects of villages are as follows:—The water is too often drawn from shallow wells or from small streams, polluted by soaking, or from stagnant pools or ditches, and its supply is limited. Often there are no means for carrying away the dirty house-water, and it is thrown on the ground and soaks into the soil close to and under the cottage; the excreta are generally thrown into an ashpit near the house, or pass into a cesspit in the ground, into which they gradually soak, polluting both ground and water. All sanitary appliances are, in fact, often wanting. Attempts are now being made to purify and then to guard the wells; to collect rain-water in proper tanks when other sources are wanting; or to store the water collected from the surface-soil of some area secure from drainage, manuring, or like impurities (as recommended by Mr. Bailey Denton). For the disposal of the slop-water, open or partially-closed surface drains leading to ditches, or underground drains that shall allow the water to flow into the soil, and other plans have been proposed. It is, on any plan, important—but especially if shallow wells or the surface soil are to furnish the drinking water—to carry off to a distance all the slop-water by drains of some kind. For the removal of excreta (as sewers are generally out of the question) a pail system, with or without the use of dried earth or charcoal, according to circumstances, has to be used. If the cottages have gardens, then the simplest dry-earth plan, with proper storage and the subsequent digging into the gardens at intervals of not more than three or four weeks, seems to answer well; yet it is very difficult to get peasants to attend even to this simple matter. If the village be a large one, then conjoint action in the procuring, drying, and distributing the earth, and in the removal of the mixed earth and excreta, answers well when care is taken. In other cases a pail system, with weekly or fortnightly removals

without the use of earth or other appliance, can be employed, and may answer, as the manure has some value.

These seem at present the directions in which the opinions of medical officers of health are tending where villages and labourers' cottages are concerned, and where larger works cannot be undertaken. The object, of course, is to obtain by simple means, and at not too burdensome a rate, the same results which are arrived at in towns by more costly plans, namely, to ensure pure drinking water, and to remove foul house-water and excreta; or, in other words, to ensure purity of the water, of the air, and of the ground.

III. Houses.—The inside of a house is supposed to be beyond the control of the Public Health Authority, and is so to a large extent, but not altogether. The law takes cognizance of the existence of nuisance inside, as well as outside, a house; and has special provisions for securing wholesomeness of habitation in the following cases:—

1. *Common lodging-houses* have been regulated since the great Public Health Act of 1848, the authors of which were evidently profoundly impressed with the great evils of overcrowding. These houses are registered and inspected; the number of lodgers is fixed; and ventilation, and cleanliness, and water-supply are attended to (Public Health Act, 1875, clauses 70–89). A certain cubic space per head in the sleeping-rooms of these houses is generally fixed by the Authority. In the Metropolis (where Acts of 1851 and 1853, administered by the police, remain in force) 240 cubic feet, in Dublin and many other towns 300 cubic feet, are required for each adult inmate.

2. *Cellar-habitations.* Since 1848 it has been unlawful to use cellar-habitations, unless they are in accord with certain conditions of space, height, window area, drainage, &c. In the Public Health Act of 1875, Clause 72 affirms these conditions afresh, and Clause 71 makes it unlawful to use any cellar as a dwelling (that is, a place where any person passes a night) which has been built or rebuilt after the passing of the Act, or which was not lawfully in use when the Act was passed.

With the supervision that has been given to common lodging-houses during the past thirty years, they have become much healthier and more decent habitations. During the same period the number of cellar-dwellings in our towns has much decreased, and the condition of those still used has notably improved.

3. '*Houses let in lodgings*,' or occupied by members of more than one family. These are distinguished from *common* lodging-houses, where common occupation of a single room by persons of different families, or occupation for very short periods, has been the distinction that one and another authority have relied on to establish their *common* quality. The regulation of tenemented houses, as the present class may conveniently be termed, dates from the Sanitary Act of 1866. At present, by Clause 90 of the Public Health Act, 1875, Sanitary Authorities have various important powers conferred on them in respect of that large class of houses where two or more families live in the same house. But, for these powers to arise, the consent of the Local Government Board is required.

4. *Overcrowding.* The Nuisances Removal Act of 1855 (18 and 19 Vict. c. 121) empowered the Sanitary Authority, on the certificate of the medical officer of health or of two qualified medical practitioners, to take proceedings before a justice to abate overcrowding if the inhabitants consisted of more than one family. In the Public Health Act of 1875, clause 91 makes overcrowding, when dangerous to the health of the inmates, whether of the same family or not, a nuisance to be dealt with as such under the Act. Some towns have also provisions in their local Acts, giving them the same authority, and in this way the immense evil of overcrowding is sought to be lessened. The question arises what is overcrowding, and usually the common lodging-house rules are taken, namely, an air-space of 300 cubic feet per head. But there is no legal amount, except in Scotland, where the General Improvement and Police Act of 1862 enacts that children under eight years of age shall have 150 cubic feet, and persons over that age 300. Obviously, the standard of space per person adopted as the minimum in the *bedrooms* of common lodging-houses, where the occupation is by night only, is too small for those who have to occupy the same room both by day and night, as is usually the case, where the question of over crowding arises in the dwellings of the poor It would be very desirable to raise the minimum (at all events for persons over ten years) to 400 cubic feet, and this is really little enough.

The law, then, in these several ways acts directly upon houses, and if any nuisance is reported, or if houses are found to be dangerous or unfit for habitation, further powers come into play.

Although public authority does not extend to all the conditions which are next to be passed in review, it will be convenient to consider together the various

CAUSES OF UNHEALTHINESS OF HOUSES.

1. *Dampness.*—Dampness arises from a damp soil, water rising into walls, rain beating through walls or coming from a leaking roof, or blocked water-pipes. Paving, concreting, damp-proof courses, hollow walls, &c., are the remedies. Damp houses are unhealthy, it would appear, by reason of the lowering of warmth, giving rise to catarrhal and rheumatic affections, and perhaps by reason of increased decomposition of organic substances from the constant excess of moisture.

2. *Excessive coldness of air from draughts or from insufficient warming.*—Although an airy house is the healthiest, there may be, not too much, but imperfect, movement of air, so that strong currents are caused; or the temperature may be lower than is good for health, even if persons are well-clothed. The draughtiness is matter of construction, and is obviated by proper plans of ventilation. Then, as to warming. In towns, the use of hot-water and steam pipes heated by a furnace common to several houses will, no doubt, soon supersede our present inefficient and expensive fireplaces, and since the supply of warmed

fresh air is a very simple proceeding when these pipes are used, not only will houses be better warmed, but better ventilated and less draughty.

3. *Impurity of the air.*—This arises from the following conditions:—impure air drawn from ground or basement into the house, or passing over impure earth or deposits; air in house contaminated by effluvia from closets and pipes; from combustion; from respiration and skin-transpiration; from uncleanliness of persons, clothes, walls, floors, and furniture.

Each of these conditions has to be examined into and rectified according to the usual rules laid down in works of hygiene. A few remarks may, however, be permitted on some of the headings.

The removal of respiratory impurities can only be accomplished by constantly removing the air of rooms and supplying fresh air. This is ventilation, which on account of the very mobile character of air and of the ease with which its currents are reversed, is a mechanical problem of no little difficulty. The amount of air required for an adult, in order to keep the air free from any odour, is 3,000 cubic feet per hour; the carbonic acid of respiration, which is taken as a measure of respiratory impurity, should not exceed ·2 per 1,000 volumes of air. Practically, the amount most persons get is not more than 600 to 1,200 cubic feet per hour, if so much, and the air of their rooms smells fusty from organic effluvia. In cold times of the year, the entering air must be warmed, if such great changes are to take place as is implied in the supply of 3,000 cubic feet, or in the change of air in the air-space three, four, or even five times per hour. When warmed to nearly the temperature of the surface of the body (80° to 90° Fahr.) considerable movement of air is borne without difficulty, but if the temperature be much lower a correspondingly slighter movement is felt. Ventilation in this climate is therefore inextricably mixed up with warming, and thorough ventilation of our rooms is impossible so long as we trust to radiant heat alone for warmth. The problem, therefore, which engineers have to solve in warming and ventilating our rooms, is what is the cheapest and most constant plan of introducing warm air, of a temperature under 90° or 95°, into our houses in cold weather, the conditions of the problem being a supply of 3,000 cubic feet per head per hour, at a rate of movement imperceptible to the feelings of the persons in the room.

The second point is connected with the impurity of the air from drains. The first thing is to be certain that the air of the house-drain is so thoroughly disconnected from the air of the town sewers that no reflux from them is possible; and, therefore, that if there is any drain air polluting the atmosphere of the house it is not the air of the common sewer. That point having been settled, it will follow that drain-smell in the house must come either from the ground or from the house pipes or closets themselves. If from the ground, there is probably (if the ground itself be clean, or if the smell be of new production) a leaky pipe somewhere, and the air is penetrating through the interstices of the soil and is drawn into the house; every house should have a plan of its drainage, so as to facilitate the search for a broken pipe. If not from the ground, the smell may be from some pipe in the house; this arises from imperfect junction, especially when metal pipes are joined on to earthenware, or from the pin-hole eating-away of metal pipes. Or a drain-pipe may be choked (generally through 'settling' at a joint occurring in an ill-laid and badly-bedded pipe), and decomposition be going on in its retained contents. Or there may be a clogged or imperfect trap with the water either sucked out of it or becoming thoroughly charged with fœtid effluvia. In the latter cases, there is a presumption that the ventilation of the house-drain is not what it should be.

In order to detect any of these conditions it is necessary that builders should alter all their plumbing arrangements; at present they try to conceal everything, so that, without pulling a house to pieces, it is impossible to examine if pipes and traps are in order. Instead of this every pipe should be kept out of walls and above ground, and if cased with wood, the case should be merely bolted, and not nailed. If a pipe must be carried underground it should be laid in a regular channel which can be opened; but, as far as possible, all pipes should be above ground and open to sight, and none should run under houses. The sewage and foul water arrangements of our houses will never be satisfactory till these matters are attended to, and till the examination of every pipe about the house can be made without difficulty, and clogging or air and water leakage detected.

In closets the chief points of leakage are the horizontal pipes and the traps. In all cases the soil pipe should be ventilated by a pipe carried to the open air at some point away from windows.

Another matter to be guarded against, whether there be drain-smell or not about a house, is the immediate opening of the cistern overflow-pipe, or of the usual rain-water pipe, into the sewer or house-drain; the common practice is to open them into the sewer, perhaps with a sigmoid trap, which, however, is often dry at the top of them. Then sewer air passes up and enters the cistern, or rooms which happen to be near the top of the rain-water pipe. All these pipes should open in free air over a grating, and if every householder would insist on the builder attending to these matters the chances of inflow of sewer air into houses would be much lessened.

Another, third, point of importance is the way in which the products of gas-combustion are allowed to pass into the air of rooms. Nothing can be worse than the usual arrangement; and, as gas-lights might be made a valuable means of ventilation if tubes were arranged to carry off the burnt gas, the present plan of chandeliers is not only hurtful, but involves an ignorant waste of useful force.

4. *Impurity of the Water.*—Water delivered to a house may become impure on the premises, usually from uncleaned uncovered cisterns, absorption of air from drains by the surface of the water, and sometimes by more direct leakage from pipes into cisterns. Lead may also be taken

up. The remedies for these conditions are obvious.

5. *Impurities from Uncleanliness of the House.* Walls and ceilings all absorb impurities which are given out again to the air, and often become highly impregnated with organic matters. The chinks of floors allow matters to collect below them, and then impure air rises into the room. Or furniture may harbour dirt, and thus continually contaminate the air.

The custom of re-papering walls without cleaning the old paper, the decomposition of paste and paper on damp walls, and the use of arsenical pigments, may disengage impurities. In the houses of the poor which are not regularly whitewashed, the half-crumbling plaster is often highly charged with animal material.

These matters are to be avoided by original good construction and by constant cleanliness. It is a great desideratum to make walls of impermeable material, so that they may be washed without difficulty; but, at present, this is an expensive matter.

If these various points, which are really questions of purity of air and water, and of temperature and movement of air, are properly dealt with, houses must be healthy. These are conditions which are not difficult to secure if they are clearly understood and if their importance is not underrated. The great point is to have the house-air pure, so as in no way to injure or depress the great function of respiration.

While we look to the Municipality or Local Sanitary Authority to keep the outer air pure, the task of doing the same for the house-air must necessarily fall on the inhabitants of the house.

Vital Statistics.—The attention now paid to Public Health is in a large degree owing to the careful collection of the statistics of births and deaths, and of the causes of death, which have been tabulated in England for the last thirty-eight years. It may truly be said, indeed, that not only all Europe, but gradually the entire world, has been influenced by the work of the Registrar-General of England. We are now able to determine the limits of mortality and its causes with some precision, and are being led towards interpreting the causes of too high a death-rate.

The chief vital statistics bearing upon public health are the determination of the birth-rate; of the general death-rate; of death-rates according to sex, age, and disease; and of the health of classes of the community, as judged of by their expectation of life at given ages. There are many other problems, but these are the most important. The collection of statistics of sickness, apart from mortality, has not been hitherto successful, on account of the difficulty of collecting the data with sufficient accuracy. *See* Morbidity.

The gross death-rate, without distinction of sex or age, is that which is commonly used to express the health of a town or district. It is, of course, to be understood that it is but an elementary expression that should be accompanied by further analysis of mortality according to diseases and ages, and by consideration of the birth-rate also, for the deaths of newly born and young children form always a large item in the list. As far as it goes, however, the general death-rate is extremely useful. It is calculated on the population, which in England is ascertained positively by census every ten years, and in the intervals may be very fairly estimated from a variety of data ascertained for the particular place or district. It was in view of gross death-rates in various districts of England that it was assumed in 1848, when the first Public Health Act was passed, that in this country the public health is nowhere satisfactory if the death-rate of the locality exceed 23 per 1,000 of population per annum. And under the provisions of that Act the General Board of Health constituted by it was empowered to send an inspector to examine into the hygienic condition of any locality, wherein the number of deaths annually exceeded this rate. It would now seem that the number proper to be regarded as constituting a standard for such a purpose, might reasonably be lowered from 23 to 22 or even 21, but no legal or authoritative statement has been made of late years. *See* Mortality.

Further investigation of mortality statistics according to age and disease is, however, necessary to form a correct notion of the sanitary state of any district. Unexpected results are sometimes brought out, as, for example, that a general high death-rate may be owing entirely to an extremely high infantile mortality. The diseases which occasion the high death-rate will then also appear, and will indicate the directions for remedial measures. The child death-rate (that is, the death-rate at ages below five years, or even for every single year of the five, calculated on the population living at the several ages; or if that be not known, then on the gross population) is indeed most necessary to be known in every health-enquiry.

Among the poor population of our large cities the deaths of children under five years of age may be found to constitute half of the total deaths at all ages, and occasionally in some bad districts in unhealthy towns the deaths of children have reached 60 per cent. of the total deaths, whereas in all England the child death-rate (under five years) is but 40 per cent. of the total deaths, and in healthy districts and good families is below this, even below 30 per cent. of total deaths. In this way of reckoning, however, the excessive mortality of infants is obscured by an excessive mortality among older people; and a better measure is to be found in the rate of annual mortality among 100 children under five years of age living in a community. Thus measured, it is found that there may die annually only four among the better classes, and from ten up to the immense mortality of twenty-six in the worst parts of our large towns.

How wonderfully the child death-rate is influenced by the high social position of the parents, which implies greater care of the children, is strikingly shown by Mr. Ansell's very useful tables of mortality among the upper classes.

Of 100,000 children born alive there are living at the end of their fifth year in all England 74,000 (in round numbers we may say that one quarter have died), among the 'upper classes'

(as defined by Mr. Ansell), 87,000 are living at the fifth year, while among the peerage not less than 90,000 are living. As a contrast, the writer would refer to a street in Liverpool, where he found the death-rate so high that only 10,000 children would be living at the end of five years out of 100,000; or 90 per cent. had died in five years.

The determination of the *diseases* producing a given mortality is also a necessary part of all vital statistics, regarded as expressions of the public health.

The chief diseases causing mortality under five years of age are diarrhœa and convulsions from bad food; acute chest-affections from cold and exposure and vitiated air; and the contagious infantile diseases. The mortality from these causes is of course greater in amount among the children of the poor. Among older people phthisis and chest-affections, and from time to time outbreaks of infectious diseases, hold the first rank.

The degree of prevalence of the infectious or so-called zymotic diseases must be always carefully noted, but there are many other preventible diseases quite as worthy of attention, and especially the acute and chronic chest-affections which are largely owing to removable unhealthy conditions of atmosphere and mode of life.

The calculations necessary to bring out the result are of the most simple kind if the data are known, namely, the number of the population, and of persons of various sexes and ages; the number of deaths, the sex and age of the persons dying, and the diseases causing the mortality.

The national census furnishes some of these figures, and the medical profession contribute the material for the rest. They bear, therefore, a very great responsibility; for inaccuracy of record by them may greatly affect the action of the community, taken on the faith of the accuracy of the statistics.

Heretofore statistics of mortality alone have been available for the purposes of the sanitary physician and administrator, and their utility has been unquestionable. Such statistics, however, are necessarily a very incomplete measure of the influences affecting the public health. When, in the future, it shall have become possible to make proper record of all sickness, whether fatal or not fatal, further progress in the investigation of the conditions productive of disease, and in securing for the community the most healthful circumstances of life, will become practicable.

The third statistical point to which reference has been made is the length of life a person of a given age may expect to live. This so-called 'expectation of life' or 'mean after-lifetime' is the most exact test of the general health of a people. It is one, however, which can only be applied at long intervals, and by the aid of very accurate and numerous census and death lists. It is not, therefore, applicable as a daily method of determining the degree of health. It appears, however, that, at the present time, as compared with former periods, the expectation of life is improving in the chief European countries, and the mean age at death is also greater than formerly.

It is the office, then, of the statistician, by his study of the distribution of disease and the incidence of mortality, to guide towards an appreciation of the causes thereof, and to a better knowledge of the natural laws which influence public health: and it is the business of the sanitary legislator and administrator to give due recognition to those natural laws in their endeavours to maintain the health and to save the lives of the people. The struggle with disease and death is never-ending, but is not indecisive. It is remarkable how steadily public health has improved with each new advance in wise legislation. In no case has disappointment resulted, and in some instances the good results have been really surprising. Much still remains to be done, and many sanitary problems wait for solution; but the rapid progress of late years makes us confident that greater effects still will follow as the knowledge of the causes of disease becomes more precise, and the technical means of prevention are more efficiently applied.[1]

E. A. Parkes.

**PUERILE** (*puer*, a boy).—This word is associated in medicine with the respiratory murmur when it is exaggerated, possessing the characters heard over the lungs in a healthy child. *See* Physical Examination.

**PUERPERAL DISEASES.**—The diseases associated with parturition, which fall for consideration in the present article, are:—1. Puerperal Convulsions; 2. Puerperal Fever; 3. Puerperal Peritonitis; and 4. Puerperal Thrombosis and Embolism. Certain other pathological conditions of equal importance, occurring during the puerperal state, are more conveniently discussed under their several special names. *See* Pelvic Abscess; Pelvic Cellulitis; Pelvic Peritonitis; and Phlegmasia Dolens. Puerperal insanity is described in the article Insanity, Varieties of.

1. **Puerperal Convulsions.**—Synon.: Puerperal Eclampsia; Fr. *Convulsions des femmes enceintes et en couche*; Ger. *Eklampsie in der Schwangerschaft und im Wochenbett.*

Definition.—A pecular kind of epileptiform convulsions, characterised by loss of consciousness and of sensibility, together with tonic and clonic spasms; occurring in the later months of pregnancy, during labour, or after delivery; and causing great danger to the lives of both mother and child.

Ætiology.—The frequent association of this disorder with albuminuria had till lately given rise to the belief that it is the result of uræmia. More recent observations, however, have thrown a doubt upon this doctrine. Many cases have been observed in which albumen was present in large quantity without convulsions occurring; and others in which the eclamptic attacks took place without any albumen, or a mere trace only, being present.

Traube and Rosenstein have referred the causation of the convulsions to acute cerebral

[1] This article, which was written by Dr. Parkes before his lamented death, has been revised, and a few passages inserted, marked [ ], by Dr. George Buchanan.

anæmia, resulting from changes in the blood incidental to pregnancy, the watery condition of the blood being associated with increased tension of the arterial system. More recently, Dr. Angus Macdonald, of Edinburgh, has pointed out that he has discovered by *post-mortem* examination, extreme anæmia of the cerebro-spinal centres, with congestion of the meninges, without œdema. He attributes the convulsive attacks to irritation of the vaso-motor centre from an anæmic condition of the blood, produced by the retention in it of excrementitious matters which should have been eliminated by the kidneys.

Symptoms.—Although frequently the convulsions occur suddenly, no previous indications having been observed, still on inquiry it will generally be found that certain premonitory symptoms have been present. The most prominent of these is headache, sometimes very intense, generally frontal. Derangement of vision is another grave indication. An important sign when present is œdema, which may attract notice by puffiness of the face, especially of the eyelids, and should immediately suggest an examination of the feet and ankles, and of the urine.

When the convulsive seizure occurs it cannot be mistaken. The eyes first become fixed, and rapid contraction of the muscles of the face occurs, with rolling of the eyeballs, the pupils being lost under the upper eyelids. The face becomes turned first towards one shoulder, then towards the other. The convulsions rapidly extend to the other parts of the body; after a short period of tonic contraction violent clonic spasms occur. The face becomes livid, the tongue is protruded, and, if care be not taken, it is lacerated by the teeth, colouring the frothy saliva which has been emitted at the angles of the mouth. The thumbs become clenched in the palms, and violent jerkings of the arms occur, whilst the muscles of the face give rise to a variety of contortions. Sometimes involuntary evacuations of the bladder and rectum occur during the fit. There is total loss of consciousness and sensation. After a few minutes the symptoms gradually subside; a longer interval occurs between the clonic muscular contractions; the face loses its lividity; and the breathing becomes more tranquil. After the first fit has passed off the patient may recover her consciousness; but if another occur with rapidity, and very little time elapses between the paroxysms, death may soon supervene. Where there is a considerable time between the attacks, it may be many hours or days before consciousness is restored, and recovery takes place. A remarkable feature of this disorder is that when the patient becomes sensible, and is restored to health, she has invariably no recollection of what occurred not only during her illness, but for some time preceding the fits. The writer has observed the case of a woman whose puffy face attracted his notice in the City of London Lying-in Hospital the morning after her labour; there was œdema of the ankles, and the urine contained abundance of albumen. Having remarked that it was a wonder she had not had convulsions, he was summoned to find her in this condition within a few hours. She was comatose for three days, and on subsequent inquiry she had no recollection of being taken in labour or of being conveyed to the hospital. This is by no means an exceptional case.

Prognosis.—This depends upon the severity and frequency of the paroxysms. It is generally considered that one in every three or four cases proves fatal. The mortality has probably diminished of late years, since indiscriminate venesection has been abolished, and other treatment adopted.

Treatment.—The treatment of puerperal convulsions depends greatly upon the period in relation to labour at which the eclamptic attack occurs. Generally the paroxysms in themselves are sufficient to provoke labour, and if this proceed well, it should be allowed to take its own course; officious manipulation is apt to increase the severity of the fits. Under some circumstances, however, the induction of premature labour is necessary; or it may be expedient to deliver as soon as possible when labour has commenced. Venesection, which used to be the universal treatment, is now very rarely adopted. There are, however, cases in which it is undoubtedly called for; in women of plethoric habit, with congested face, and full pulse, showing much arterial tension, it will probably be found of great benefit.

Compression of the carotids, first recommended by Trousseau in the convulsions of infants, has been successfully adopted by Dr. Playfair in puerperal eclampsia.

As soon as the attack commences it is well to administer an aperient, if possible.

The treatment which has of late been found most serviceable is the administration of chloroform, which not only modifies the force of the attacks, but appears in a marvellous way to diminish their frequency. It should be freely administered on the first symptoms of the attack, and its effect should be kept up until the fit has entirely subsided.

Chloral alone, or in combination with bromide of potassium, may be administered by the mouth or rectum, often with great advantage. This may obviate the necessity of a further continuance of the chloroform inhalation. The hypodermic injection of morphia, which has been condemned by some on account of the renal condition, has, nevertheless, been frequently found most efficacious, notwithstanding a large amount of albuminuria being present, and it is well worthy of a more extended trial in prolonged cases.

2. **Puerperal Fever.** — Synon.: Childbed fever; Puerperal Septicæmia; Fr. *Fièvre puerpérale*; Ger. *Puerperalfieber*; *Kindbettfieber*.

Definition.—A continued fever, occurring in connection with child-birth; often associated with local lesions of the uterus, vagina, or perineum; and caused by the absorption of septic matter, not infrequently arising from the retention of portions of placenta or membrane, or from a putrid fœtus.

Ætiology.—Puerperal fever occurs not only epidemically but endemically, especially in lying-in hospitals; and is communicable by contagion. Special sources from without are cadaveric matter communicated by the hands of the practitioner after making *post-mortem* examinations and

septic matter conveyed by nurses on their hands or on sponges. Prolonged mental distress, and an impoverished state of the blood from want of food, predispose to it. Puerperal fever may be produced by the contact of other diseases, especially erysipelas, which in some respects bears a close analogy to it, a prominent characteristic of both being a peculiar diffuse inflammation; in one the part affected being the skin and connective tissue, in the other the seat being the uterus, uterine veins, and peritoneum.

Anatomical Characters.—These differ very greatly according to the duration of the fever, and the parts of the body affected by the disease. In some rapidly fatal cases of a malignant type nothing has been found but a peculiar alteration in the blood—a great increase in the white corpuscles; a diminution in the red blood-cells; an increase also in the fibrine and extractive matters, lactic acid and fat; and frequently traces of bile-pigment.

Generally, however, local lesions exist, and if these are seen after death, in the shape of lacerations in the genital tract, they will present an unhealthy appearance, their edges being swollen and œdematous. The uterine surface is generally found intensely inflamed, softened, and occasionally in a state of slough. The results of inflammation may also be found in the veins, parenchyma of the uterus, and connective tissue around it; as well as in the lymphatics, so large and numerous at this time, pus being frequently discovered in these vessels. The peritoneum is nearly always affected; it may be only congested in patches, but is generally universally so; the intestines may all be glued together; and the sac may contain more or less serum or sero-pus, with flaky lymph. Inflammatory swelling, softening, or abscesses may be found almost anywhere, in the uterine wall, ovaries, kidneys, spleen, liver, lungs, muscles, and connective tissue. Effusion into all the serous cavities may arise, and pus may be discovered around, or even within, the joints. An embolus may be found, a fragment of infected thrombus having escaped.

Symptoms.—In no disease do the symptoms vary more than in this, depending upon the violence of the fever, and the localities attacked by the poison. The fever generally originates within three or four days after delivery, though sometimes later. Frequently there is, first of all, great depression, with headache; sometimes the first symptom is a rigor. The pulse becomes rapid and feeble, 130 or more per minute. The temperature rises to 103° Fahr., or higher. The skin is generally hot and dry. Vomiting frequently occurs early, the ejecta being like coffee-grounds, and of a peculiar odour. Diarrhœa is often very troublesome, the evacuations being horribly fetid. The tongue soon becomes coated with a heavy fur, later on becoming dry and raspy; and sordes appear on the lips. There is often acute pain, with tenderness and swelling, of the abdomen; but peritonitis with effusion may occur without any of these symptoms. Sometimes the swollen, tender uterus can be felt in the hypogastrium. The lochia are generally suppressed, and the secretion of milk arrested, though sometimes the mammæ are hard and painful. As a rule the intellect is unimpaired, though low muttering delirium frequently precedes death. The breathing is short and hurried. Pneumonia, pleurisy, or pericarditis occasionally ensue. Jaundice or albuminuria may be present. The joints may swell and suppurate; and abscesses may form in any part of the body, sometimes in the eye.

Course and Terminations. — The disease generally runs a rapid course, terminating fatally within a week. The pulse becomes more and more rapid and feeble; the breathing more hurried and panting; tympanites sets in; a cold clammy sweat breaks out; finally hiccough, subsultus, and low muttering delirium come on, with frequently incessant vomiting; and the patient sinks from exhaustion.

Treatment.—1. *Prophylactic.*—This is of the utmost importance. Keeping in mind the sources of the disease, it behoves the practitioner to avoid every means of communicating septic matter to the patient, either personally or by the nurse. If possible to arrange it, the genital organs should never be touched, for the purposes of examination or otherwise, without the hands having been first thoroughly rinsed in a solution of pure carbolic acid (1 to 20). All sponges should be permanently kept in a similar solution; and all instruments, such as vaginal syringes or catheters, be thoroughly soaked in the same before use. Instead of cold cream, a preparation containing 1 drachm of absolute carbolic acid to $2\frac{1}{2}$ oz. of benzoated lard should be employed for lubricating. The utmost care should be observed, to avoid the smallest piece of the placenta or membrane being left within the uterus. Subsequently all washings or syringings of the genitals should be performed with a solution of carbolic acid (1 to 40). The practitioner should order all these preparations to be in the house previous to the expected time of delivery.

2. *General.*—The general treatment varies with the character of the disease. At first active antiphlogistic remedies may be indicated; and in some cases local depletion by leeches, in others blisters. Drugs, such as veratrum viride (much employed in America), aconite, digitalis, or salicylic acid, may be useful in lowering the temperature. The internal administration of turpentine has been highly extolled; this drug is often very efficacious when applied on hot flannel to the abdomen, or used as an enema where there is much tympanites. Opium, or morphia, is invariably demanded to subdue restlessness, allay pain, and induce sleep. Laudanum, applied in poultices to the abdomen, is sometimes very grateful to the patient. When, however, there is much tenderness and distension, a paste composed of two parts of extract of belladonna to one of glycerine, brushed thickly over the whole abdomen, will be preferable. Quinine is often of great value in diminishing the fever; it may be given in doses of 10 or 15 grains night and morning. Warburg's tincture may answer still better. The antiseptic douche should never be omitted; and a long vaginal tube should be employed, so as to ensure the fluid passing within the uterus. If used warm it is often very comforting, especially when the discharges are fetid. In cases of a more chronic type, where diarrhœa is a prominent symptom, tincture of

perchloride of iron in large doses, 20 to 30 minims, is sometimes very serviceable. One of the most important elements in the treatment of this exhausting disease is the frequent administration of nutritious food and stimulants—strong beef-tea, milk, eggs, champagne, or brandy—in small quantities at short intervals. In cases of obstinate vomiting recourse must be had to nutrient enemata. The most abundant supply of fresh air that can be admitted with safety should be secured.

It is impossible to map out any distinct line of treatment for puerperal fever. Each case must be combated according to its individual symptoms, and demands constant attention; for, though the disease is fearfully fatal, some of the most apparently hopeless cases recover.

**3. Puerperal Peritonitis.**—This, though one of the most frequent complications of puerperal fever, sometimes occurs independently of it, other symptoms than those consequent upon the local inflammatory attack being absent.

Anatomical Characters.— The *post-mortem* appearances, associated with puerperal peritonitis, differ only from those described in connection with puerperal septicæmia inasmuch as they are confined to the peritoneal cavity. There will probably be found an abundance of effused serum or sero-pus, and flaky lymph, intense congestion of the peritoneum, and the abdominal viscera will here and there be glued together. The uterus will probably be found preternaturally soft.

Symptoms.—Generally within a week following delivery a well-marked rigor occurs, followed by febrile disturbance. The patient complains of acute pain in the lower part of the abdomen, at first in one particular spot, but soon spreading over a larger area. The thighs become flexed on the abdomen to relieve the tension; the belly becomes much swollen, and excessively tender; and there are generally much tympanites and obstinate constipation. The pulse is very characteristic, being quick, wiry, and incompressible. Vomiting soon sets in. If the disease do not give way, the abdomen becomes more swollen and tense, and no pressure upon it can be borne. Everything that is taken is vomited; the pulse becomes more rapid and feeble; the tongue is dry and raspy; the constipation gives way to diarrhœa; the skin becomes clammy, and the extremities cold; and the patient dies.

Treatment.—The application of leeches to the abdomen, immediately the tenderness is complained of, may be of much service in subduing the local inflammation, and allaying pain. Opium is the drug of all others to be relied upon. Hot fomentations and counter-irritants, such as turpentine, often give great relief. In the first stage a copious enema of thin gruel with castor-oil, to obtain a free action of the bowels, should be given. Where there is much tympanites, the addition of turpentine may be of benefit in dispelling the flatus. If vomiting prevent nourishment being taken by the mouth, it should be administered *per rectum*.

**4. Puerperal Thrombosis and Embolism.**

Definition.—The occurrence of a blood-clot in the right side of the heart or pulmonary arteries either formed *in situ* or conveyed there from a distance by the blood-current, often giving rise to sudden death after delivery.

Anatomical Characters,—The condition of the blood in pregnancy and the puerperal state renders it liable to form a coagulum, and this may occur in distant vessels. It is well known that in the later months of pregnancy the amount of fibrin in the blood is very greatly increased. Together with this a diminution in the volume of the blood from uterine hæmorrhage produces a state of exhaustion, which causes a great predisposition to thrombosis. If, therefore, such having occurred in distant vessels, a portion of coagulum become detached, and be carried away till it reach the pulmonary arteries, embolism is the result, and this is one of the great causes of sudden death occurring after parturition. It has been shown, however, that pulmonary thrombosis may occur independently of embolism; large, firm, decolourised coagula have been found, on *post-mortem* examination, occupying the right side of the heart and the larger branches of the pulmonary arteries, which have evidently formed there, all traces of thrombosis elsewhere being absent.

Symptoms.—These are common both to embolism and pulmonary thrombosis. In the great majority of cases, the patient is suddenly seized with severe dyspnœa; she starts up and gasps for breath; the face in some cases has been described as pale, in others livid. She feels she is dying, and calls out for air; the pulse becomes almost imperceptible; and generally death occurs very rapidly. In some cases, however, in which the clot is not sufficiently large to entirely obstruct the circulation in the lungs, it appears that absorption may ultimately take place and recovery ensue. Dr. Playfair has published some cases which support this theory.

Treatment.—In almost every case so rapidly fatal is the seizure that there is no time to think of treatment. When, however, the attack is not so terribly rapid in its termination, every effort must be made to rally the patient, by the administration of stimulants, such as brandy, ether, or ammonia, if at hand. The most perfect rest must be enjoined, so as to prevent the coagulum from becoming dislodged, and to promote its absorption. Dr. Richardson has recommended liquor ammoniæ in large doses, with a view of dissolving the fibrin. Clement Godson.

**PUERPERAL INSANITY.** *See* Insanity, Varieties of.

**PULLNA,** in Austria.—Sulphated waters. *See* Mineral Waters.

**PULMONARY APOPLEXY.**—A term for a certain form of hæmorrhage into the lungs. *See* Lungs, Hæmorrhage into.

**PULMONARY DISEASES.** *See* Lungs, Diseases of.

**PULMONARY VESSELS, Diseases of.** The vessels of the pulmonary circulation, more especially the veins, enjoy a considerable immunity from disease. Primary affections of these are of most exceptional occurrence, and the causes leading to their being secondarily involved are not numerous. It is not easy to account for this. The pulmonary arteries rarely present those

diseased states which are of frequent occurrence in the arteries of the systemic circulation, and are not even as commonly affected as the systemic veins, with which they somewhat more closely agree in point of structure, and in the kind of blood carried by them. The portal vein, which is comparable to the pulmonary artery in other respects besides its plan of distribution, would appear to be similarly free. For these reasons affections of the pulmonary vessels are rather of pathological interest than clinical importance; in the majority of cases they are not to be recognised during life, or, if so, are beyond the application of any treatment. The trunk of the artery, and especially the orifice in the right ventricle, is singularly liable to present congenital abnormalities, which are treated of in the article HEART, Malformations of.

1. **Inflammation.** — ÆTIOLOGY. — Arteritis affecting the pulmonary artery, whether acute or chronic, is of very rare occurrence. Previous to birth it seems to be more liable to exist than subsequently, and some of the congenital deformities of the pulmonary artery and its valve are to be attributed to it. No satisfactory explanation has been offered of the greater tendency of the right heart and vessels to inflammation before birth, and of the left side and aorta subsequently. After birth it is almost invariably associated with such acute blood-diseases as pyæmia, or with those pyrexial states which are apt to assume a septic character, as scarlet fever. Very rarely cases are met with where no cause can be ascertained; but it is said that whilst syphilis favours arteritis in the aorta, chronic alcoholism predisposes to its development in the pulmonary artery. Emboli, especially if of a putrid character, which have become lodged in branches of the vessel, are very liable to set up inflammation in the contiguous walls.

ANATOMICAL CHARACTERS.—These correspond with the usual characters of arteritis. The process begins in the sub-epithelial layer of the inner coat, and results in the formation of a variety of connective tissue, which consists of fibres, fusiform fibre-cells, and homogeneous material; these constituents being developed in varying proportions, and forming patches of grey gelatinous or semi-cartilaginous material. The formation of pus and abscesses within the thickness of the walls, and their subsequent rupture into the lumen of the vessel, are practically unknown. The valves at the commencement of the vessel are the most frequent seat of inflammation, but it has been seen in the main trunk of the vessel. When the vessels have become much dilated, as from extreme mitral stenosis, the walls thus thinned are liable to undergo changes of a chronic inflammatory character (*see* ARTERIES, Diseases of). This state is only demonstrable after death; during life it is not recognised, except the valves be affected, by any known signs or symptoms, and a diagnosis of its existence has not hitherto been attempted. Under such circumstances no plan of treatment can be laid down.

2. **Degenerations.**—(*a*) *Atheroma.*—This, as in the systemic arteries, occurs in two forms. The one form is a sequence of inflammation, when the patches of grey translucent material above-mentioned undergo fatty degeneration, and, as Virchow pointed out, tend to ulcerate, whilst similar patches in the aorta are more liable to calcify. The other form consists in a fatty degeneration of the deeper layers of the intima without any previous inflammation, and occurring as part of a general atheroma of all the vessels. It is in vessels whose structure has been much altered by distension that atheroma is most frequently seen. Calcification of the atheromatous areas is not unknown. No symptoms are to be referred to this condition, though Dr. Walshe suspects that 'in some instances it aids in the production of pulmonary apoplexy.'

(*b*) *Albuminoid degeneration.*—This has been recorded as having been seen in the muscular coat of branches of the pulmonary artery.

3. **Ulceration.**—As already said, inflammation of the vessel-walls very rarely extends to ulceration of the inner coat, but owing to the extreme frequency of ulcerative destruction of the lung-tissue, the intra-pulmonary branches of the vessels are constantly involved. Phthisis of whatever kind, abscess, or gangrene of the lungs, will each in their progress invade the vessels, the walls of which, though offering considerable resistance to the destructive process, sooner or later yield, and may be the cause of a fatal hæmorrhage, though very frequently a loss of blood is prevented by blocking up of the vessels with coagula.

4. **Dilatation and Aneurism.**—ANATOMICAL CHARACTERS.—Varying changes of abnormal distension are not unusual, occurring in both sexes and in all ages beyond childhood, and are estimated as forming 3 per cent. of aneurisms of all kinds. The dilatation may affect the trunk uniformly; and an extreme case has been recorded where the circumference of the vessel attained $6\frac{1}{8}$ inches, the normal average being taken at $3\frac{1}{2}$ inches. Or, limited in extent, the bulging forms a sacculated, or, more rarely, a dissecting aneurism of the trunk or branches, from the size of a walnut to a pea, or even smaller, these latter being frequently multiple. The conditions which lead to these alterations in the normal calibre of the vessel are:—(*a*) Those causing a diminished resistance of their coats to the blood-pressure, especially if this be increased, which is often the case, by obliteration of some vessels, and consequent rise in tension in the remaining ones, or by general obstruction, such as mitral stenosis or emphysema would cause. (*b*) Those changes in the lung-structures which diminish the support of the vessels, and so allow of their yielding. The results of arteritis and atheroma will furnish the first condition, and ulceration and destruction of the pulmonary tissue will provide the latter. The walls of true aneurisms may be thicker or thinner than those of the healthy vessel, and it is remarkable that their contents are never laminated coagula, even in the largest, but always fresh clots.

An extreme case of distension of the pulmonary veins is recorded (*Dublin Journal*, 1832), especially the left, where the vessels were dilated to four times their normal size, owing to extensive obstructions at their openings into the left auricle.

SYMPTOMS.—When the main trunk of the

pulmonary artery is the seat of an aneurismal tumour, there are the usual signs of pulsation and prominence in variable degrees, most marked to the left of the sternum in the second intercostal space; over the same area a systolic bruit of a superficial quality is to be heard, not conducted above the sternum or clavicles; and a systolic thrill is to be felt. There is also accentuation of the second sound, with the signs of hypertrophy of the right ventricle. Should the tumour be of any considerable size, it will give rise to those conditions which commonly follow an obstruction to the pulmonary circulation—namely, lividity, dyspnœa, cough, and general anasarca, with scanty, high-coloured urine. In an exceptional case pallor of the face was noticed. Pain behind the sternum, and headache also exist. Since the greater part of the artery is included within the pericardium, it is into that sac that rupture will probably occur.

The small aneurisms of the intra-pulmonic branches give rise to no known symptoms until hæmoptysis indicates their rupture.

Diagnosis.—An aneurism of the trunk of the pulmonary artery may have to be distinguished from a similar affection of the aorta, or from a post-sternal tumour to which pulsation has been communicated. The tendency of pulmonary aneurism to extend to the left side, and the non-conduction of the bruit to the vessels at the root of the neck, with the coincident signs of pulmonary obstruction, are grounds upon which to found a distinction.

Prognosis.—This is of necessity grave, whatever the size of the lesion, and many cases of fatal hæmoptysis are due to rupture of a small-sized sac.

Treatment.—How far such treatment as galvano-puncture, the administration of iodide of potassium, &c., as pursued in aneurism of the systemic vessels, is applicable to similar affections of the pulmonary artery, is unknown. For the treatment of the hæmorrhage to which their rupture gives rise, *see* Hæmoptysis.

5. **Stenosis.**—A narrowing of the pulmonary artery may take place at the orifice in the conus arteriosus, or more rarely in the trunk or main branches. In the former situations it is commonly congenital, the result of endocarditis or myocarditis, which, if developed within the first three months of fœtal life, is almost invariably accompanied by some compensating lesion, such as intraventricular communication; whilst if the affection of the heart be subsequent to the third month of development, the circulation is carried on through a patent foramen ovale and ductus arteriosus (*see* Heart, Malformations of). It is conceivable that stenosis of the conus arteriosus may be followed by secondary narrowing and closure of the pulmonary artery, and also that defective development of the lungs may cause a narrowed vessel. The condition is very rarely due to any acquired change in the vessel-walls, although a case is recorded of stenosis of the artery from cartilaginous thickening and calcification of its coats. The calibre of the tube may be diminished by the pressure of tumours, such as an aortic aneurism or adenoid growths, or by the shrinking of cicatricial tissue in the adjacent lungs.

When stenosis is developed at a very early period of fœtal life, the artery remains exceedingly narrow behind the obstruction. When it occurs late, the vessel may be of normal capacity, and if insufficiency co-exist with the obstruction, it may even be dilated (Lebert).

Symptoms.—Whatever be the cause of pulmonary stenosis, there will be a deficient supply of blood to the lungs, producing dyspnœa, and the obstruction to the circulation will give rise to all the signs and symptoms of general venous congestion, although to a less degree than in affections of the tricuspid orifice. Hypertrophy of the right ventricle, as evidenced by increased transverse measurement of the area of cardiac dulness; a basic thrill; a systolic bruit, of maximum intensity over the heart's base, and conducted to the left of the sternum, but not audible along the course of the aorta and great vessels; and a marked accentuation of the second sound—are the most important diagnostic signs of this condition. Cyanosis is not a characteristic, and does not occur unless there be extreme venous congestion, or a communication between the two sides of the heart. The association of constriction of the pulmonary artery, both congenital and acquired, with tubercular phthisis, has now been too frequently observed for it to be regarded as a coincidence only, and their relation as cause and effect is generally admitted.

Treatment.—This affection is entirely beyond the reach of remedy.

6. **Rupture.**—Violent effort and great excitement have been followed by rupture of the pulmonary artery, either of the trunk or main branches; it is said, even without previous disease of the vessel (Chevers, 1846). But in the majority of recorded cases the coats were degenerated. Death is often instantaneous, but very frequently is delayed, even some hours. Aneurisms tend to burst sooner or later; those of the trunk usually opening into the pericardium, while the intra-pulmonary dilatations commonly rupture into cavities in the lung. Ulceration, as said, is of very rare occurrence, but a case is recorded of its existence and extension through all the coats of the vessel, with a suddenly fatal termination. Rupture of the pulmonary veins has been recorded.

7. **Embolism and Thrombosis.**—The pulmonary artery is especially liable to become plugged, both by substances lodged in it from elsewhere, and by coagula originating in the vessel itself. Its relationship to the venous circulation explains this. Portions of broken-down clots developed in the systemic veins, from whatever cause; the contents of hydatid and other cysts that have burst into the venous current; fragments of cancerous and other new growths, all of which readily travel onwards towards the heart, pass into the pulmonary artery, in the branches of which they become lodged, according to their size. Once located, the plug will increase in size by the deposition on it of successive layers of fibrin, sometimes to such an extent as to obliterate all traces of the original obstructing substance. Occasionally very large thrombi are detached in the systemic veins, and are arrested in the trunk and main branches of the pulmonary artery. The causes of thrombosis of the vessel are various

The rare occurrence of inflammation or degeneration of the artery renders obstruction of the vessel from primary thrombosis very uncommon; but the development of clots in the smaller branches, in association with pneumonia, phthisis, gangrene, and other destructive lung-diseases, is frequent. In certain septic states, in parturient women, and in conditions of extreme anæmia, especially with diminished heart-power, when the blood is prone to clot in the vessels, the pulmonary artery is a favourite locality for this to occur. Thrombi may commence in the right ventricle, or, as would appear, sometimes on the semilunar valves, and extend into the trunk and, for variable distances, into the branches of the vessel. Such obstructions are frequently developed during the last hours of life, when the circulation is enfeebled and slow. *See* EMBOLISM; and HEART, Thrombosis of.

SYMPTOMS.—The symptoms will, of course, depend upon the extent and completeness of the obliteration of the pulmonary circulation. If only the smaller branches be occluded, there may be no symptoms to be directly ascribed to the obstruction. A very moderate dyspnœa or slight hæmoptysis would be equally attributable to the phthisis or other lung-state which had determined the formation of the thrombi.

In another class of cases, when larger branches are blocked, very marked dyspnœa is developed, with such symptoms as are conveniently grouped under the term 'anginal,' such as pain in the præcordia, a sense of great distress and faintness, palpitation, lividity, and extreme pallor, with cold sweats, but no loss of mental faculties, and an almost imperceptible pulse. The onset of such a condition may be gradual or rapid; in the former case it depends on the slow increase in size of a small thrombus; in the latter, on the sudden lodgment in some branch of the artery of a solid substance that has entered the venous current. In some cases these symptoms are present to an extreme degree, and death follows in a few minutes; in fact, this lesion constitutes one of the causes of sudden death. The appearances are not those of asphyxia, and it is usual to attribute the very rapidly fatal result to syncope or shock, as it would seem to be connected in some way with an arrest of the nerve-governance of the heart. In that class of cases which do not terminate so quickly, it is usual to find that the symptoms abate somewhat, and may be followed at a variable interval of hours or days by a second or even several attacks, finally ending fatally. The *post-mortem* examination of such cases shows a thrombus of considerable extent, with indications of its having been formed at different times.

Examination of the chest reveals no diagnostic signs. There is very likely to be a basic systolic murmur conducted along the course of the pulmonary artery; but this is not constant.

DIAGNOSIS.—This is often very uncertain. The conditions in which thrombosis is usually met with, such as anæmic or parturient women, are those in which breathlessness, cardiac pain, and discomfort, and even a pulmonary hæmic bruit, are of frequent occurrence. The symptoms, when not of extreme rapidity, are very similar to those caused by stenosis of the pulmonary artery, which in itself is difficult to diagnose; and, lastly, the suddenly fatal cases are almost identical in their manifestations with rupture of the heart or of a thoracic aneurism, or even angina pectoris. The supervention of the above-detailed symptoms in a case of existing phlebitis, in a woman within twelve or fourteen days after child birth, renders it highly probable that they are due to a clot in the pulmonary artery.

PROGNOSIS.—This is to be looked upon as of the gravest character, if once symptoms arise which indicate the existence of a clot in the pulmonary vessels. The smallest plugs formed in branches which are being invaded by a progressive destructive change in the lungs, are protective in character, and prevent or diminish an hæmoptysis which erosion of the vessels might produce.

TREATMENT.—In the most rapid cases death takes place before anything can be done; but in the less severe cases two points have to be attended to, namely, absolute rest, and free stimulation by brandy, ether, and ammonia, for by such means only can any hope be entertained of preventing an extension of the clot. Sinapisms over the cardiac region often afford relief.

W. H. ALLCHIN.

**PULMONARY MURMUR.**— This word may be employed in two senses, namely as signifying, first, the respiratory sound heard over the lung; or, secondly, a bruit heard in connexion with the pulmonary artery and its valves. *See* HEART, Valves of, Diseases of; PHYSICAL EXAMINATION; and PULMONARY VESSELS, Diseases of.

**PULMONARY VALVES AND ORIFICES**, Diseases of. *See* HEART, Valves of, Diseases of; and PULMONARY VESSELS, Diseases of.

**PULSATION** (*pulso*, I beat).—Pulsation is a sensation of beating or throbbing, either objectively appreciated by inspection or palpation, or subjectively felt. It originates in the presence of a pulse or rhythmical rise and fall of blood-pressure, whether normal or abnormal, in connection with the part where it is situated. In most instances this is either the heart or some large blood-vessel; but in other instances the pulsation has a different origin, especially when the phenomenon is abnormal. As instances of *normal* pulsation may be mentioned the cardiac impulse; the arterial pulse generally; the pulsation of the umbilical cord; and the beating of the fontanelles. *Abnormal* pulsation may be referable (1) to dilatation of a blood-vessel, as in aneurism; (2) to vascular dilatation and cardiac enlargement, as in aortic incompetence; (3) to vascular dilatation and cardiac excitement, as in exophthalmic goître; (4) to interference with the passage of blood through a vein, or even regurgitation into it, as in the jugular pulse of tricuspid disease; or (5) to the presence of a tumour upon a large vessel, conveying the normal pulse unnaturally to the surface of the body, as in tumour of the pancreas or pylorus. Pulsation may also be present (6) in any part when it is the seat of inflammation, the small vessels being dilated; (7) in aneurism by anastomosis; and

(8) in malignant disease of bone, which may closely simulate aneurism.

With respect to the characters of this phenomenon, it is of great practical importance to distinguish *true* expansile or eccentric pulsation from pulsation which is *communicated* only. In the former case the seat of pulsation expands rhythmically in all directions; in the latter case it is moved in one direction only, that is, it rises and falls under the influence of the motion conveyed to it.

The various pathological conditions which give rise to pulsation, and their treatment, are fully discussed under appropriate heads.

J. Mitchell Bruce.

**PULSE, The.**—Synon.: Fr. *le Pouls*; Ger. *der Puls.*—Each contraction of the heart, by throwing the contents of the left ventricle into the aorta, causes a sudden change in the fulness of the systemic arteries, which is manifested by elongation and dilatation of these vessels. When the finger is placed upon an artery, which runs on a resisting plane, such as the radius forms beneath the radial artery at the wrist, slight compression by the finger enables us to detect an increased hardness in the vessel at each cardiac contraction. It is this increase of hardness, or fulness, or, in other words, this change in the distension of the artery, which constitutes the pulse. In feeling the pulse the finger slightly compresses the artery, and thus flattens it; the cylindrical form is restored by each pulsation. The amount of pressure required to flatten the artery completely, is the rough and ready way of estimating its fulness or tension, and is best performed by compressing the vessel with the index finger, whilst the middle and ring fingers, placed more distant from the heart, check off the pressure required to stop the blood flow.

The movement of the artery perceived by the finger appears in most cases to be simple, but when registered by the sphygmograph it is found to be a compound of three waves, called the *summit wave*, the *tidal wave*, and the *dicrotism*. The *summit wave*, which caps the line of ascent of the trace, is due to the sudden vibration in the blood-column, following immediately on the lifting of the aortic valves by the discharge of the contents of the left ventricle. The *tidal wave*, or *wave of impletion*, or *first secondary wave*, as it is also called, is due to the distension of the arteries, following the increased pressure in the aorta and great vessels, from the reception of the ventricular contents. The *dicrotism*, or *great secondary wave*, is an oscillation of the blood-column, mainly, if not wholly, produced by the rebound of the blood from the closed aortic valves under the pressure of the aortic recoil. *See* Dicrotism.

A pulse-trace (fig. 55) consists then in a *line of ascent*, *a* to *b*, which ends in the *summit wave*, *b*, and corresponds to the first part of the ventricular systole; from the summit wave the tracing falls slightly, till it is again raised by the *tidal wave*, *c*, due to the impletion of the vessel. After the tidal wave a more marked descent occurs, called the *aortic notch*, *e*, and the line again rises, into the *dicrotic wave*, *d*. The *line of descent*, *b* to *a'*, is thus broken by two waves and two notches. The two waves have already been described; of the two notches one precedes the tidal wave, and indicates a slight collapse in the arterial wall after the oscillation called the summit wave; whilst the aortic notch preceding the dicrotism marks the fall in pressure in the arteries antecedent to the closure of the aortic valves.

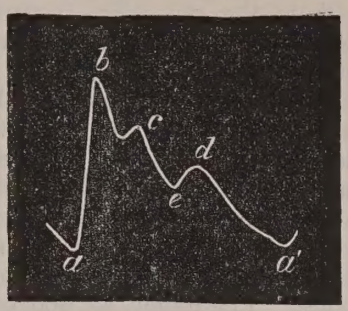


Fig. 55. Typical pulse-trace. *a* to *b*, line of ascent; *b* to *a'*, line of descent; *b*, summit wave; *c*, tidal wave; *d*, dicrotic wave or dicrotism; *e*, aortic notch.

The moment these valves are closed the line of descent rises again. It is the bottom of this notch, marking as it does the closure of the aortic valves, which points out the termination of the ventricular systole. The remainder of the line of descent corresponds with the diastole of the ventricle.

The pulse-trace is modified in its chief features by the state of arterial fulness or tension. When the tension is high (fig. 56) the line of ascent is less lofty; the tidal wave is large, and

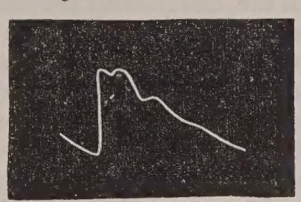

Fig. 56. Trace of pulse of high tension.

often blended with the summit wave; the aortic notch is shallow; the dicrotism is not much developed; and the line of descent is gradual. When the tension is low (fig. 57), the line of ascent is lofty; the summit wave distinct; the tidal wave small; the aortic notch deep; the dicrotism

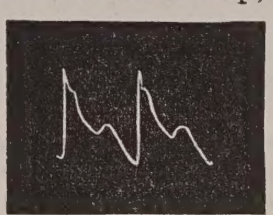

Fig. 57. Trace of pulse of low tension.

highly developed; and the line of descent sudden. These modifications are interfered with, if the normal elasticity of the arteries be lost, as in arterial degeneration.

The pulse thus registered by the sphygmograph, or felt by the finger, is a movement of the blood-column, primarily caused by the heart, but greatly modified by the properties of the blood-vessels. On the heart depend the rate, the rhythm, and, to some extent, the force of the pulse; whilst on the vessels depend the mode of the blood-flow, and the ease of its passage. By virtue of their elasticity, the larger arteries con-

vert the intermittent, jerky impulse given to the blood by the heart-beats, into an even flow of regular waves; and the smaller arteries regulate, by their permeability, the ease with which the blood-stream flows onward to the veins, thus governing to a great extent the fulness or tension of the arterial system.

The art of feeling the pulse consists in discovering, from the sensation imparted to the finger, the condition of the arterial wall and the arterial contents. When the artery is felt to be hard and cord-like, rolling more or less rigidly under the finger, changes in the arterial coats, due to degenerative arteritis or senile change, are indicated. The radial artery is sometimes congenitally anomalous, and a high bifurcation of the vessel or other peculiarity may account for the absence or smallness of the pulse on one or both sides. The finger, as above mentioned, also estimates the fulness of the vessel from its compressibility, and hence learns how the heart and arteries are acting. The effects of their action on the form of the pulse-wave the sphygmograph records. In children the pulse may often be most accurately observed in the temporal artery during sleep. *See* SPHYGMOGRAPH.

It will be convenient to consider in succession the *frequency*, the *rhythm*, and the *force* or *strength* of the pulse.

1. **Frequency.**—The frequency of the pulse depends on the rate of the heart's contractions. This rate varies with age, position, sex, stature, and a number of physical and psychical influences. In the newly-born infant the heart and pulse beat some 130 to 140 times a minute. The rate gradually falls, and after the sixth year it is usually below 100; and a further decrease of 30 beats a minute gradually occurs before the rate of manhood (70 to 75 a minute) is reached. In old age the pulse-rate often rises again slightly.

In the erect posture the pulse beats at some 10 a minute in the male, and 7 in the female, over the sitting rate, and some 5 more over the rate of the recumbent position. The female of seven years has some 10 pulse-beats a minute more than the male of the same age. As regards stature, we may say briefly that height diminishes the number of beats slightly, a man of 6 feet having a pulse of 3 or 4 slower than a man of 5½ feet.

Movement and exertion of all kinds quicken the pulse, and mental emotion or excitement in neurotic persons runs up the rate very high. In examining healthy people for life assurance, as well as when visiting patients, this must be taken into account. A good meal increases the fulness and frequency of the pulse, and so does the use of stimulants in health, though in acute diseases the reduction of the pulse-rate is often the test of their beneficial action. The pulse is less frequent during the night and during sleep; it rises in frequency during the early hours of the day.

*Increased frequency.*—Such are the conditions which affect the pulse-rate ordinarily in healthy persons. In disease increased frequency is one of the most common changes, as, for example, the frequent pulse of all pyrexial attacks. The pulse-rate and the pulse-form, as recorded by the sphygmograph, are closely connected with the temperature-elevation. The pyrexial pulse-trace shows important modifications in the dicrotic wave, which becomes more and more developed as the pyrexia increases. The aortic notch deepens, and when it reaches the level of the curve-basis (the line joining the commencement of each line of ascent) the pulse is called *dicrotous* or *fully dicrotous*; this form corresponds with a pulse-rate of over 100 per minute, and a temperature of about 103° Fahr. When the aortic notch sinks below the level of the curve-basis, and the dicrotic wave is blended with the line of ascent of the next pulsation, the pulse is called *hyper-dicrotous*, and the temperature is generally at or over 104° Fahr. (*see* fig. 62). The pulse-rate in many febrile cases becomes a prognostic sign of great value, sometimes, as in puerperal cases, being of more value than the temperature.

*Diminished frequency.*—A reduced pulse-rate is less commonly seen. It is met with in certain cases of blood-impurity, such as jaundice, anæmia, and diabetes; in convalescence from pneumonia; in relapsing fever; in fatty degeneration of the heart; and in some nervous affections, especially of the medulla. In one of these last cases the writer has observed a pulse of 24; and a rate as low as 14 a minute has been recorded.

2. **Rhythm.**—The rhythm of the pulse depends also on the rhythm of the heart; regular heart-action produces regular pulse, and *vice versâ*. Variations in rhythm are of two kinds, *intermittence* and *irregularity*.

*Intermittence.*—Intermittence means the omission of a beat from time to time. This omission may occur at regular intervals, for example, every tenth or twentieth beat; or it may occur irregularly, so that every now and then a beat is missed. Intermissions occur more rarely in the young than in the old, and may be associated with no other evidence of disease. In some cases nervous excitement will produce them; in others they depend on hypochondriasis, dyspepsia, the excessive use of tobacco, gout, over-work, and on fatty degeneration or some neurosis of the heart. Occasionally an intermittent pulse is the first indication of deep-seated malignant disease. Some patients are unconscious of the intermissions, while others feel the heart stumble in its work, as it were, at each last beat. In many persons intermissions are habitual, and do not necessarily indicate disease, but they impair the life-value. Intermittent action is often observed in old persons otherwise healthy.

*Irregularity.*—Irregularity, the other variety of disordered rhythm, presents itself in two forms, as irregularity in frequency, and irregularity in force or inequality. These two forms are frequently associated; of a number of pulsations no two may seem equal in force, and no two may succeed each other at equal intervals of time. In other cases a number of good, steady beats, regular in frequency and equal in force, may be followed by a disorderly series, unequal and irregular. These abnormalities are best observed in cases of mitral valve disease and in dilatation of the heart, although the pulse may be unequal and irregular in all forms of heart-disease at some period of their evolution. Mitral insufficiency affords the common examples of unequal and irregular pulse, though in this affection the pulse-beats may only be slightly unequal

in size and form, but perfectly regular in the periodicity of their occurrence. In mitral stenosis irregularity and intermissions are generally associated with inequality. Some intermissions are what are commonly called *false* intermissions, the ventricular systole being too weak, or the wave of blood thrown into the aorta too scanty, to be perceived at the wrist. In such cases the sphygmograph records the wave which escapes the finger. In mitral cases irregularity and inequality are increased by exercise. *See* SPHYGMOGRAPH.

Inequality in the size of the pulsations often depends on respiratory influences. Deep inspiration normally reduces arterial tension, lessens the size of the pulsations, and quickens the pulse; while expiration raises the tension, increases the size of the pulsations, and slows the pulse. An exaggeration of these effects constitutes the *pulsus paradoxus* or *pulsus inspiratione intermittens*. In some cerebral cases the regular succession of large and small pulsations is observed, constituting the *pulsus alternans* or *bigeminus*.

In health the pulse may sometimes be noticed to be irregular on waking; and in convalescence from acute disease irregularity in force and time is not infrequent.

The pulse may be occasionally *suppressed* in one or all the arteries. When general, this is due to cardiac weakness, and the sphygmograph will often record a small gradual pulse-wave, which escapes the finger. When partial, the suppression is due to either compression, thrombosis, or aneurism of the main trunk.

The pulse in one radial occasionally is felt to occur later than in the other artery; this is called *retardation*, and usually indicates aneurism.

3. **Force.**—The force of the pulse, which the finger estimates by the amount of pressure required to obliterate it, and which the sphygmograph measures by the weight or pressure required to develop to the full the main features of each pulsation in the trace, is the product, in the first place, of the heart's vigour. The distribution of the heart's force, however, depends on the state of the smaller blood-vessels. When these are relaxed and open, a vigorous heart has its force distributed quickly over the whole vascular area by the rapid onward passage of the blood. When, on the contrary, the arterioles are contracted, the heart's force is retained in the arteries for a longer time. In the first case, the pulse is soft and compressible, from the small quantity of blood retained in the artery; in the second case, it is hard and incompressible, from the fulness of the artery with blood under high pressure. It may be well to point out here, that the size of the pulse and the amplitude of the pulse-trace are by no means fair indications of its force or strength. These qualities depend on the sudden variations in tension (fulness of blood) which the artery undergoes. For instance, a moderately strong ventricle will produce in states of easy blood-flow through the capillaries an ample pulse, but one easily compressed; whilst the same ventricle, acting with even more force, in conditions of lessened capillary permeability, will produce a pulse much less ample, but less easily compressed. The simple experiment of feeling, or recording with the sphygmograph, the pulse when the capillaries are dilated by a warm bath, and, again, when contracted by a cold one, will exemplify this. The permeability of the smaller vessels also reacts on the heart, and influences both the frequency and mode of contraction. When the capillary circulation is easy, the heart's action is more frequent, and the ventricular contractions shorter or more sudden; when, on the contrary, the circulation is obstructed by contraction of the peripheral vessels, the heart's action becomes less frequent, and the ventricular contraction is longer and less sudden. Thus the vascular tension may be said to be in inverse proportion to the frequency and suddenness of the heart's action. The force of the pulse, as thus modified by the state of the peripheral circulation, gives us some of our most important clinical information. Modern clinical research shows how valuable is a study of this force of the circulation as manifested by the tension of the arteries. It is this quality of tension which forms the best basis for the division of the various pulse-forms into the two great classes of *hard* and *soft* pulses, or pulses of high and low tension. The *hard* pulse requires considerable pressure to enable the sphygmograph to record its features to the full; the soft pulse yields the best trace to slight pressure.

**Other Characters.**—The *size* of the pulse depends on the development of the line of ascent and the tidal wave, which are modified by the volume of blood expelled by the ventricle, and the state of fulness of the arteries. When the arteries are contracted the pulse is hard and wiry; when the coats are relaxed it is large and soft. The *flickering* pulse is indicative of feeble and unequal ventricular contractions; and the *undulatory* character noticed in some weak pulses is due to the influence of the respiratory movements, causing variations in the tension. The quality of *suddenness* (quick ventricular systole) is betrayed by a nearly vertical line of ascent; while the *gradual* pulse (slow ventricular systole) has an oblique up-stroke.

The following arrangement shows in a small compass the principal varieties of pulse met with in practice, apart from the quality of regularity.

**A. Varieties of Hard Pulse—Pulsus durus.**

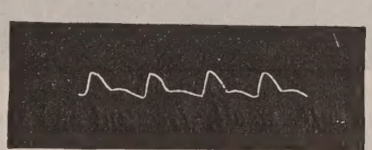

FIG. 58.

1. The *hard, frequent, sudden, and small pulse* of peritonitis, enteritis, and pericarditis:—

*Pulsus durus et frequens et celer et parvus*, fig. 58.

2. The *hard, slow, gradual*, and *large pulse* of contracted kidney:—

*Pulsus durus et rarus et tardus et magnus*, fig. 59.

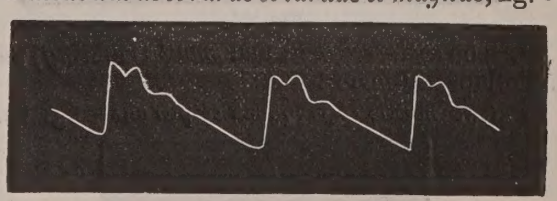

FIG. 59.

3. The *hard, large*, often *gradual pulse* of cardiac hypertrophy and degeneration of blood-vessels:—

*Pulsus durus et magnus et tardus*—fig. 60.

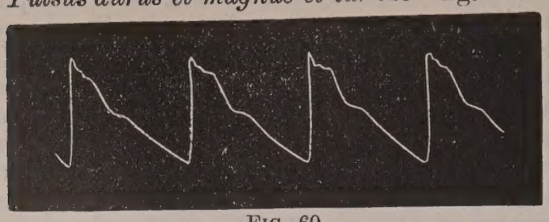

Fig. 60.

4. The *hard, sudden* (*jerky*), *large*, and *vibratory pulse* of aortic insufficiency, with strong ventricle :—

*Pulsus durus et celer et magnus et vibrans*—fig. 61.

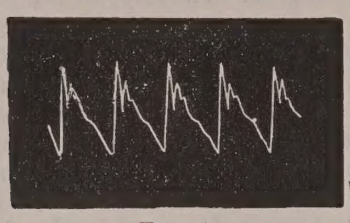

Fig. 61.

B. Varieties of Soft Pulse—**Pulsus mollis.**

1. The *soft, frequent pulse* of pyrexia: dicrotous and hyper-dicrotous pulses :—

*Pulsus mollis et frequens*—fig. 62.

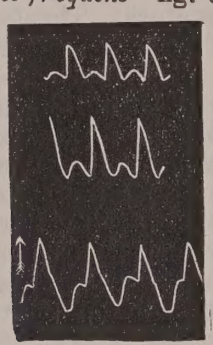

Fig. 62.

2. The *soft, frequent*, and *large pulse* of rheumatic fever :—

*Pulsus mollis et frequens et magnus*—fig. 63.

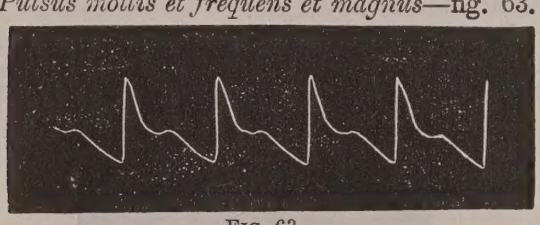

Fig. 63.

3. The *soft, small, frequent* and *sudden pulse* of debility :—

*Pulsus mollis et frequens et parvus et celer*—fig. 64.

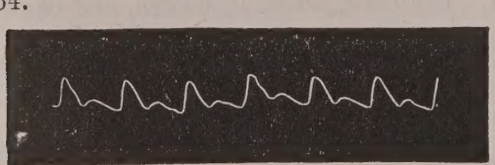

Fig. 64.

4. The *soft, frequent*, and *small* (*running*) *pulse* of collapse in fever :—

*Pulsus mollis et frequens et parvus*—fig. 65.

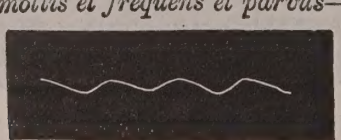

Fig. 65.

Balthazar Foster.



**PUPIL, Disorders of.**—Synon.: Fr. *Troubles de la Pupille*; Ger. *Störungen der Pupille.*—This normally-black aperture in the varicoloured and more or less pigmented diaphragm called the iris, lies immediately in front of the lens of the eye. It is circular, or nearly so; and central, or rather nearer the nasal than the temporal side of the iris. Through the pupil light is transmitted to the retina, and, speaking generally, its size is in inverse proportion both to the amount of light admitted, and to the age of the individual. The activity and dilatability of the pupil, and the range within which it will vary in size, are greatest in the young, and least in old people. Its size varies very much in different persons exposed to the same amount of light. A diameter of from 3 to 5 mm. in ordinary daylight would be nothing unusual. The best method of measuring the size of the pupil is to have a row of black dots, of from 1 to 10 mm. diameter, which may be held up beside it for comparison. The exercise of the accommodation-power of the eye for near objects, and the act of convergence of the axes of the two eyes for the same purpose, are accompanied by contraction of the pupil. It is probably by exercising these voluntary powers that some persons, it is said, can contract their pupils *at will*. Hypermetropes, who make much use of their accommodation, have small, and, on the contrary, myopes have large pupils, as a rule. The iris has circular and radiating muscular fibres, by which the size of the pupil is altered. The radiating fibres of the dilator muscle are supplied by the sympathetic (through ciliary nerves from the lenticular ganglion), and also, probably, by the long ciliary nerves of the trifacial; and the sphincter pupillæ by the third nerve. So that in paralysis, or after section, of the third nerve, the sphincter being inefficient, the pupil is, in some degree at least, abnormally dilated, and irresponsive to light (mydriasis); and, on the contrary, contracted and immovable when the eye is shaded (myosis), if the sympathetic is defective. The pupil is quite passive, as regards the light and shade, and of an uniform and medium size, if both nerves are powerless. Paralytic mydriasis, or myosis, is not so much in degree as that produced by belladonna (atropin) and other mydriatics, or by calabar bean (eserin) and other myotics, respectively. If, for instance, in a case of complete third nerve paralysis, the ordinary solution of sulphate of atropine is dropped into the eye affected, the pupil becomes more widely dilated, and hence the drug is supposed to paralyse the sphincter of the normal eye, and to stimulate the dilator muscle simultaneously—to produce, in fact, an artificial mydriasis, simulating at once the paralytic and spasmodic forms of the disease. For mydriasis from disease may be a result of spasmodic action of the dilator, or of defect in the sphincter—of irritation of the sympathetic, or of paralysis of the third nerve. In the latter case only will atropine produce a greater dilatation. The converse is the truth as to the production of myosis from disease, from cerebral irritation, or from any disease paralysing the sympathetic. An exceedingly minute quantity of the sulphate of atropine locally applied will produce mydriasis, so that care must

be taken not too readily to assume in any case that mydriasis has not been artificially produced.

Mode of Examination.—In estimating the movements of the pupil in an eye that is not blind, as the two irides have a mutual action, the other eye must, in the first place, be altogether covered and excluded; and then, opposite a good light, the effects of shading and exposing the eye alternately are observed. If it 'acts' doubtfully (reflex movement), the effect of using the accommodation, assuming that the power is retained, as in reading, and then, with both eyes open, of converging the axes, in looking at a very near object (voluntary movement), is to be tried. It should be observed also whether the pupil *dilates* normally when, in a moderate light, the patient looking into the distance, the eye is shaded. For want of care, mydriasis of one eye has been mistaken for myosis of the other, and *vice versâ*. The normal reflex excitability of the pupil is also noteworthy. If one of the extremities be irritated, if only the palm of the hand be scratched or tickled, the pupil will then dilate. The changes in size of the pupil, thus accurately tested in any case, are a very uncertain guide as to the amount of vision in the eye examined. If an eye has no perception of light (amaurosis) its presence or absence has no influence (though this is disputed) on the pupil, which is generally dilated, if the blindness is not of spinal origin, and especially if it is recent.

Varieties and Ætiology.—There are many other well-known signs of paralysis of the third nerve besides the dilated pupil, and but one of the signs only is very unlikely to appear in any such case. The disease may, however, be limited to the lenticular ganglion. As the cervical sympathetic, which supplies the dilator pupillæ, derives nerve-fibres from spinal nerves, contraction of the pupils is one of the many well-known signs of locomotor ataxy; but it is not always present. It is then of a paralytic nature. The pupils are uninfluenced by light, but contract in accommodating for near objects (Argyll-Robertson). Myosis may be spasmodic, as in the case of some watchmakers and others. Unilateral myosis may indicate an aneurism, tumour, or some other deep-seated disease on one side of the neck. The pupils are contracted when there is photophobia, and during sleep; dilated in syncope, nausea, stupor, hydrocephalus, dyspnœa, often in epileptic fits, and by various drugs given internally. A striking variability and want of symmetry as to the size of the pupils has been observed in the general paralysis of the insane. In mania the pupils are contracted, and in melancholia dilated. In 'tremulous iris,' the lens being gone or removed backwards from contact with the pupillary border of the iris, especially if the vitreous be fluid, it is moved to and fro by the movements of the eye-ball. If the lens is eccentrically misplaced, a part of the iris and pupil only may be thus shaken. *Hippus* (nystagmus affecting the iris) is a very rare condition, in which the pupil is dilated and contracted spasmodically, without any of the variations of light or other causes by which it is usually influenced. A not very uncommon congenital defect of the iris is *coloboma*—in which the pupil is balloon-shaped, the notch generally downwards. In fœtal life the membrana pupillaris covers the pupil, and some remains of this may be seen, in rare cases, in adult life, in the form of bands passing from the *front* surface of the iris, a little beyond the pupillary margin, across the pupil, or to the anterior lens-capsule. If the pupil, especially if it be somewhat contracted, is inactive, not circular, and irregular in shape, this is almost always the result of iritis, probably of existing adhesions of the pupillary margin. The pupil also mechanically, in some degree at least, may be dilated, inactive, and not round, vertically oval as a rule, in glaucoma—the lens being thrust forwards beyond the plane of the iris. On the other hand, when the tension of the eyeball is diminished, as in *paracentesis corneæ*, the pupil is at once contracted. Pupillary adhesions (*posterior synechiæ*) to the lens, as they are at the *back* of the iris, can be hardly seen unless a drop of a mydriatic solution has been used. This, if there are synechiæ, reveals them at once, as the iris can only dilate in the intervals between them. But if it have not been used before, during the inflammation, or insufficiently, the pupil becomes very much contracted, and may be altogether incapable of dilatation—excluded (*total posterior synechia*), or occluded, the iris being adherent to a false membrane which occupies the area of the pupil. *See* Eye, and its Appendages, Diseases of; and Third Nerve, Diseases of.

J. F. Streatfeild.

**PURGATIVES.**—Definition.—Substances which cause intestinal evacuations.

Enumeration.—Purgatives are divided into several classes, namely, *drastic*, *simple*, *saline*, *hydragogue*, *cholagogue*, and *laxative*. Under the *drastic* purgatives may be classed Colocynth, Croton oil, Gamboge, Jalap, Podophyllin, Scammony, and Elaterium. Amongst the *simple* purgatives are Aloes, Buckthorn juice, Castor oil, Rhubarb, and Senna. Under the head *saline* we have neutral salts, especially the Sulphates of Magnesia, Potash, and Soda; Citrate and Tartarate of Potash; Bitartarate of Potash, Tartarate of Soda, and Phosphate of Soda. *Hydragogues* include Bitartarate of Potash, Elaterium, and Gamboge. *Cholagogues* comprise Aloes; Mercurial preparations, such as Calomel, Blue pill, and Grey powder; Podophyllin, Iridin, Euonymin, and other substances of the same class. The *laxatives* are small doses of simple purgatives, such as Carbonate of Magnesia, Magnesia, Olive oil, Sulphur, as well as such vegetable substances as contain salines and sugar in considerable proportions, namely, Cassia, Figs, Honey, Manna, Prunes, Tamarinds, and Treacle.

Action.—The increased intestinal evacuation produced by purgatives is partly due to acceleration of the peristaltic movements of the intestine, so that the intestinal contents are hurried along more quickly, and less time is allowed for their absorption. Many authorities, especially in Germany, have held this to be the only way in which purgatives act; but there is no doubt that many of them also produce increased secretion from the intestinal glands. The different classes of purgatives affect the intestinal movements and intestinal secretion in different degrees. *Laxatives* and *simple purgatives* act

chiefly, if not entirely, by increasing the peristaltic action. Some of the *drastic* purgatives act in both ways; whilst the *hydragogue cathartics*, as well as the *salines*, especially increase the intestinal secretion. In the case of some of the salines, as bitartarate of potash, the secretion is greatly increased, while the peristaltic movement is so little affected that the secretion may lie so long in the intestine as to be again re-absorbed, and the drug therefore fails to produce purgation at all. For this reason it is usual to combine such salines with simple purgatives, which will accelerate the peristalsis.

Besides their direct action upon the bowels, purgatives exert an indirect effect upon the circulation, weakening it, and lowering the pressure of blood within the vessels.

*Cholagogue* purgatives are those which have a special power to remove bile from the body. They may do this either by stimulating the secretion of the liver, or by quickening the expulsion of bile from the gall-bladder and ducts, so that more bile is poured into the intestine at a time when this is in active movement. The bile is therefore hurried down the intestinal tube, and reabsorption is thus prevented. This appears to be the mode of action of such purgatives as euonymin and iridin. Such mercurial preparations as blue pill and calomel appear to act in a somewhat different way. Experiments, contrary to expectation, have shown that they do not increase the secretion of bile, and yet they are amongst the most efficient cholagogue purgatives which we possess. Their cholagogue action is probably due to their exerting a special stimulating action upon the duodenum, quickening its peristaltic movements, and thus hurrying down the bile, and preventing its reabsorption. Their beneficial action as cholagogues is greatly increased by the subsequent administration of a saline purgative, which will tend to sweep the bile out of the lower part of the small and the large intestine, and prevent reabsorption from these.

Uses.—Purgatives are used, firstly, to remove fæcal matters from the intestinal tube. They thus not only prevent the accumulation of such matters, but remove the irritation which their presence produces, and which may evidence itself in disturbances of other organs, for example, headache and malaise. These disagreeable symptoms produced by constipation appear to be partly due to the irritation of the intestinal nerves, producing reflex disturbance of the circulation; but it is probable also that they may be caused in part by the toxic action of poisonous gases, liquids, or solids generated in the intestine by imperfect digestion or decomposition of the food. For such purposes as this we may employ, as we find them necessary, laxatives or simple purgatives. The second use of purgatives is to remove from the body an excess of certain secretions such as bile, and substances which may be contained in them, such as metallic or organic poisons which are excreted in the bile or intestinal mucus. The third use is to remove liquid from the body in cases of dropsy, due either to cardiac or to renal disease. For such purposes we use hydragogue cathartics. The fourth use is to lower the temperature in fever, and for this we chiefly use salines. The *modus operandi* here is not yet well understood. The fifth use of purgatives is to lower the blood-pressure, and thus to prevent the rupture of a blood-vessel, and consequent apoplexy; or to prevent further extravasation in a case where the vessel has already burst, as in hæmorrhage from the lungs.

T. Lauder Brunton.

**PURGING.**—A popular synonym for diarrhœa; and also applied to the therapeutical method purgation. *See* Diarrhœa; and Purgatives.

**PURPURA.**—Synon. Cutaneous hæmorrhages; Fr. *Purpura*; Ger. *Blutfleckenkrankheit.*

Definition.—A diseased condition in which circumscribed effusions of blood take place into the upper layers of the cutis, and beneath the epidermis; occurring without or with certain constitutional symptoms, or in the course of various diseases; and attended at times by hæmorrhages under and from the mucous membranes, as well as into the various serous cavities.

Ætiology.—Cutaneous hæmorrhages have been seen as early as the third day after birth, and indifferently at all other periods of life. Women appear to be more frequently attacked than men.

Cutaneous hæmorrhages, when not due to external injury, may occur in persons apparently in the most perfect health, or they may accompany the most various diseases of the general system. They are not infrequent in the course of Bright's disease and valvular disease of the heart; they have been seen in phthisis, acute rheumatism, cirrhosis of the liver, leucocythæmia, intermittent fever, and, in fact, in patients of the most different constitution and general condition, from perfect health to the most advanced cachexia. The exciting cause is usually quite obscure, but they have been seen to follow severe fright, and also sudden obstruction of the circulation, as in severe coughing and epilepsy, though this is exceptional. Purpuric eruptions have followed the use of chloral in excessive doses, and also of iodide of potassium in specially susceptible individuals.

Anatomical Characters.—The rete mucosum and the papillary layer of the cutis are the chief seat of the hæmorrhage in purpura. Owing probably to rupture of the capillaries over a limited area, the blood finds its way into the meshes of the connective tissue, and fills the interspaces between the hair-follicles and the ducts which traverse these parts. Absorption of the serum is soon followed by changes in the hæmatin set free from the red corpuscles, so that it passes through various tints of blue, green, and yellow, until it is completely absorbed. Very large extravasations may result in long-continued or even permanent pigmentation of the part, owing to the formation of hæmatoidin. Similar effusions to those beneath the skin are found in the severer cases beneath the mucous membranes also; but in these parts bleeding from their free surface is not uncommon, probably from the delicacy and slight resistance of the membrane covering the capillaries. *Post-mortem* examination in fatal cases has revealed extensive

extravasation into the pleural, pericardial, and peritoneal, and, very rarely, into the arachnoid cavities. Extravasation may also occur into the muscles, the periosteum, and even the bones, as well as beneath the conjunctiva and into the retina. Cases complicated with other diseases, such as phthisis, or Bright's disease, will present their characteristic lesions.

Pathology.—Purpura appears to depend (1) on an alteration in the nutrition of the coats of the blood-vessels, which makes them unequal to the strain of arterial pressure, so that they rupture; or (2) on alterations in the blood itself (excess of water, or salts, &c.); or (3) on both causes combined. That weakness of the vessel-walls is a main cause, is shown by the greater frequency and extent of the purpuric eruption on the feet and legs, and on the most dependent parts, such as the back, if the patient be recumbent, where gravity intensifies arterial pressure. The influence of the nervous system may account for some cases of rapid hæmorrhage, for this condition has been experimentally produced in frogs by extirpation of the sympathetic ganglia.

Embolism and thrombosis have been suggested as an explanation of some cases. The relation of the joint-affections which so often accompany purpura to the latter is not clear, and there seems ground for believing that they are not always rheumatic, but due to hæmorrhages into the synovial membranes of the joints.

Symptoms.—Although, as has been stated above, cutaneous hæmorrhages may occur under such a variety of conditions that they can scarcely be looked on as characteristic of a definite disease, yet since they not unfrequently appear in apparently healthy persons, and run a definite course, it seems advisable to retain the time-honoured name of purpura in these cases, as well as to include under the generic name two or three minor species. It must, however, be distinctly understood that *there is no abrupt line of demarcation between any of the varieties of purpura*, but that the difference between them depends on the severity of the accompanying symptoms. The eruption has the same general characters in all forms of purpura. It consists of isolated spots, whose colour varies from bright red to a livid or dark purplish-red. They do not disappear on pressure. Their shape is generally round or irregular, and their edge is almost always uneven and denticulated. Their size varies usually from that of a pin's head to that of a pea or bean, but in some cases they may be as much as several inches in circumference. The smaller spots, not larger than a finger nail, are termed 'petechiæ,' the larger 'ecchymoses.' If they take the form of lines or broad stripes they are called 'vibices.' The spots are usually level with the skin, but they sometimes appear as small conical papules round the hair-follicles (purpura papulosa, lichen lividus—Willan), or as wheal-like nodules (purpura urticans). Very rarely the epidermis is raised into the form of bullæ containing serum and blood-corpuscles (purpura bullosa). The duration of each spot depends on the amount of extravasated blood giving rise to it, and on the time necessary for its absorption; but it usually disappears in a week or ten days. The spots, once formed, do not increase in size except by fresh hæmorrhage in their vicinity. They never end in desquamation, and only large ecchymoses are followed by more than transient pigmentation; but they all undergo colour-changes during absorption, by which they become brown, green, and yellow, while their edges become more and more indefinite. Their presence under the skin is unattended with pain or any kind of irritation or pruritus, so that the patient may only discover their existence accidentally while undressing.

Varieties.—We may now briefly consider the varieties of purpura:—

1. **Purpura Simplex.**—In this form the eruption is either preceded for a few days by languor and loss of appetite, or else it occurs without any previous symptom. The spots may be limited to the feet or legs, or they may be scattered over the whole body, including, in severe cases, the head and face. They come out in crops, each of which lasts from eight to ten days. There may be only one or two crops, or fresh ones may protract the disease for several weeks or months.

2. **Purpura Rheumatica.**—Synon.: *Peliosis rheumatica.*—Rheumatic purpura only differs from the simple variety in being attended with slight fever, general stiffness and weariness, and rheumatic pains in the knees and ankles. The rheumatic symptoms vary much in different cases, and in some cases the joints are not only painful and tender, but red and swollen. There may also be a good deal of gastric disturbance, nausea, and bilious vomiting; colicky pains in the belly, constipation, and diarrhœa are not uncommon. Peliosis rheumatica is most frequent in men, and in healthy individuals between the ages of twenty and thirty years. This form often relapses if the patient leave his bed too soon. Liveing connects P. rheumatica with symmetrical erythema (polymorphic erythema) through Erythema nodosum. Neither the arthritic symptoms, with purpuric tendencies, which are common to all these affections, nor the character of the eruption present, are considered to be of a sufficiently constant and distinctive nature to separate one from the other by any sharp line of demarcation.

3. **Purpura Hæmorrhagica.**—This form only differs from purpura rheumatica in the greater depression and constitutional disturbance which precede and accompany the outbreak of spots; in the greater extent of surface covered by the petechiæ; in the larger size of the ecchymoses; and, lastly and chiefly, in the occurrence of hæmorrhagic effusions beneath the mucous membranes of the lips, cheeks, gums, and palate, and of more or less copious free hæmorrhages from the nose, mouth, intestines, urinary tract, and more rarely from the lungs. The repetition of these hæmorrhages may rapidly exhaust the patient's strength, and cause death from anæmia and collapse, or he may die with so-called 'typhoid' symptoms. The hæmorrhages from internal parts do not bear any necessary proportion to the skin-eruption, and they may be very severe when the latter is small, or *vice versâ*; nor need they begin or end at the same time with it. Purpura hæmorrhagica may, like the other varieties, occur suddenly in apparently healthy

persons, living under the most favourable circumstances.

As rare complications of these three forms may be mentioned (*a*) true urticaria, running side by side with the purpuric eruption; (*b*) venous thrombosis; and (*c*) diarrhœa, not of a bloody character.

4. **Symptomatic Purpura.**—This title might be given to a purpuric eruption which sometimes occurs in the course of cholera, measles, scarlet fever, typhus fever, and small-pox, but which has no special significance except in the last-named disease. There the purpuric spots come out in the first three days, and so precede the special eruption of small-pox, and patients attacked with it frequently die with delirium and high fever.

PROGNOSIS.—The prognosis of simple and rheumatic purpura is favourable, as recovery always occurs. In purpura hæmorrhagica recovery is the rule in uncomplicated cases, though there are a few instances on record which ended fatally from the exhaustion produced by repeated hæmorrhages, although no cause could be detected, and every known remedy was tried. Purpura accompanying organic disease, such as Bright's disease or morbus cordis, is unfavourable. The duration of all the forms is very uncertain, owing to their tendency to relapse.

DIAGNOSIS.—The fact that the purpuric spots are unaltered by pressure, and unattended with itching, scaliness, or tendency to discharge, will separate them from almost every other affection of the skin. From scurvy purpura is distinguished by occurring in those whose health has not been impaired by long privation from fresh meat and vegetables; by the absence of spongy gums, painful swellings, and ulceration of the skin; and by its resistance to diet and the use of lime-juice. Secondary syphilitic stains on the lower extremities must be distinguished by the history and by other attendant phenomena. Bruises due to injury are not likely to lead to error.

TREATMENT.—In the treatment of purpura absolute rest in bed is necessary, if the eruption be general; elevation of the legs is advantageous if the disease be confined to them. Any derangement of internal organs must be remedied, if possible. As a rule, tonics, especially quinine and iron, do most good in purpura simplex. Tinctura ferri perchloridi ♏xv–xx, three times a day, is almost a specific in many cases; and the mineral acids, especially sulphuric acid, are of great value. The use of purgatives, as recommended by the older writers, especially Plumbe, has of late fallen into disrepute. In purpura hæmorrhagica, with copious bleedings, ergot has proved most effectual. It may be given either by the mouth, or else hypodermically, as a solution of ergotin. Turpentine, in ten-minim doses, gallic acid, and other hæmostatics also deserve a trial. Locally, cold applications, or injections of iced water, may be resorted to in severe epistaxis or hæmorrhage from the bowel. Iodide of potassium should not be given in purpura, as it aggravates it in some cases, and has even given rise to serious ulceration.

EDWARD I. SPARKS.[1]

[1] Revised by Dr. Alfred Sangster.

**PURPURIC.**—Relating to purpura. *See* PURPURA.

**PURRING TREMOR or THRILL.**—SYNON.: Fr. *Frémissement cataire*; Ger. *Schnurren.*—A physical sign felt by the hand applied over the heart or vessels in certain conditions, resembling the sensation conveyed by the purring of a cat. *See* PHYSICAL EXAMINATION.

**PURTON** (Wiltshire) Saline Spa, contains iodine. *See* MINERAL WATERS.

**PURULENT INFECTION.** — Infection from the absorption of pus, introduced from without, or formed within the body. *See* PYÆMIA.

**PUS.**—A product of inflammation. *See* INFLAMMATION.

**PUSTULE.** — SYNON.: Fr. *Pustule*; Ger. *Pustel.*—A vesicle of the skin containing pus, as in small-pox and ecthyma. Vesicles originally containing serum are also apt to become pustules, by a purulent transformation of their contents.

**PUSTULE, MALIGNANT.**—SYNON.: Contagious Carbuncle; Anthrax; Fr. *Charbon*; Ger. *Anthrax.*—Other names are used to designate the more diffuse and general forms.

DEFINITION.—A specific contagious disease, communicated to man from the disease of horned cattle, horses, and sheep, &c., known as splenic fever, *mal de rate*, or *Milzbrand*, and due to the presence in the system of the *bacillus anthracis* (Cohn), or *bacteridium* (Davaine).

1. The *local* or *external* form of the affection, malignant pustule proper, is a carbuncular swelling having specific characters, attended with more or less intense surrounding inflammatory œdema, which may exist alone (anthrax œdema, *œdème malin*, anthrax erysipelas); usually also with lymphangitis. Constitutional symptoms may be slight or severe; and the disease is often fatal.

2. *General* or *internal* anthrax is another result of the same poison, which may exist independently of any external malignant pustule. This form has received various names—anthrax or charbon fever (*fièvre charbonneuse*), anthracæmia, internal anthrax, *mycosis intestinalis*; and also names derived from its connection with certain trades (woolsorter's disease), or its occurrence in certain countries (Siberian plague). This internal form is apparently identical with splenic fever of the lower animals; its symptoms are usually those of blood-poisoning, such especially as prostration, anxiety, congestion of the lungs, and rapid death; fever may be only slight. The chief *post-mortem* lesions are scattered hæmorrhages in various organs; diffuse cellular exudations; congestion of the lungs; and frequently a swollen and pulpy condition of the spleen.

ÆTIOLOGY.—Anthrax, when occurring in man, is invariably derived from cases of splenic fever of the lower animals, either by direct or indirect contagion.

Splenic fever affects horned cattle, sheep, and horses in all parts of the world; and, less frequently, elephants, camels, and other herbivora. Though apparently endemic in certain regions, this is probably due to the great persistence of the contagion, and the various ways in which it is preserved, owing to the mode of disposal of

the carcases. The disease assumes various forms, usually that of a general blood-poisoning, without external swelling; occasionally a form in which there is glandular swelling and inflammatory œdema (sometimes bloody) near the seat inoculation (usually the mouth and pharynx), together with the general blood-poisoning; and, least frequently, a form in which there are local phlegmonous or diffused œdematous swellings affecting various parts of the body. In the common internal form of splenic apoplexy the spleen is usually greatly swollen and pulpy; it may even rupture, and there may be hæmorrhages in the heart, lungs, kidneys, serous cavities, and other parts.

The *bacillus anthracis* or *bacteridium* is a bacterium first discovered by Pollender in 1849, the name of *bacteridium*, given by Davaine, being that commonly used in France; that of *bacillus anthracis*, given by Cohn, in Germany.

All parts of the bodies of animals dying of the disease are actively poisonous, and may convey the disease by direct or mediate contagion. Direct inoculation is rarely, perhaps never, from the living animal, usually from the carcase, affecting, therefore, chiefly butchers, slaughterers, tanners, &c. It may also arise from eating the flesh, though rarely, as the poison is destroyed by cooking. Contagion may also be conveyed by butter or milk (Heusinger). The bites of flies may also convey the poison.

Indirect contagion occurs chiefly in those who have to deal with the wool or hair of animals which have died of the disease, especially wool-packers and sorters, labourers in felt manufactories, horsehair-cleaners, furriers, tanners, and those engaged in like occupations. In these cases the poison may enter the system either by local inoculation, or by inhalation of the dust containing it. Lastly, certain less suspected modes of infection may probably be occasionally active in relation to man as to animals. The diffusion of the poison by water, and its distribution by means of wool-waste and bone-dust, used as manure, especially deserve notice, as capable of spreading the contagion unsuspected.

With regard to animals, the researches of

Fig. 66. Part of the spleen of a guinea-pig which died of anthrax, showing the relative proportion of bacillus rods and leucocytes. (×100 diam.) From a photomicrograph.

Pasteur seem to show that the bacillus may be cultivated in the earth around buried carcases, carried to the surface by earth-worms, and so distributed on vegetation.

Morphological Characters and Mode of Growth.—As seen in the blood, the bacillus anthracis consists of a motionless, short, apparently homogeneous rod or filament, varying in length from 10 $\mu$ ($\frac{1}{2500}$ inch) to 20 $\mu$ ($\frac{1}{1250}$ inch), and in diameter averaging 1·4 $\mu$ ($\frac{1}{18000}$ inch). The filaments may greatly exceed this length, but are rarely less than $\frac{1}{2500}$ inch long.

Fig. 67. A part of the same under a higher power (×220 diam.) The rods are made to appear too thin in the woodcut. From a photomicrograph.

These filaments are either straight, slightly curved, or bent at an acute angle. The longer of them may be readily shown by reagents to be made up of numerous shorter segments, either enclosed in one sheath or showing signs of division.

In some cases longer filaments, curved or looped, are found in the blood and in the fluid of the serous cavities after death.

The mode of their development and multiplication has been studied artificially. The usual mode of multiplication in the blood is by trans-

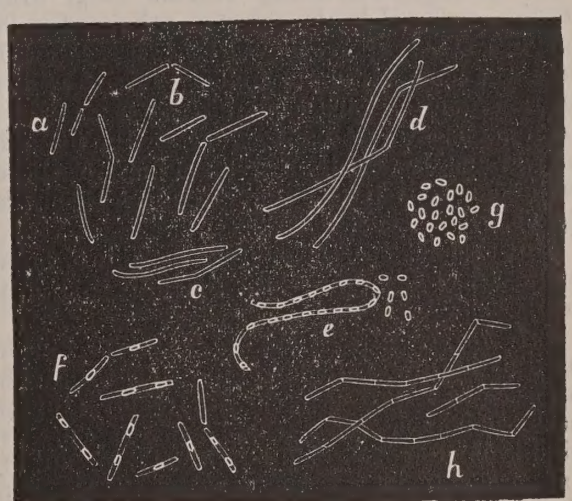


Fig. 68. Forms of bacillus anthracis. ×500. *a*. Very short rods. *b*. Rods of the usual length. *c*. Longer rods. *d*. Still longer rods, some bent, in course of division. *e*. A filament from the spleen after death, showing spore formation, and free spores. *f*. Rods in which spores have been formed, from the pericardial serum after death. *g*. A mass of spores. *h*. Jointed rods found in the spleen after death.

verse fission. The rods consist of a central protoplasmic core, surrounded by a more dense sheath. In ordinary rapid fission the rod simply increases to nearly double its length; then the central protoplasm splits in the middle, leaving a clear space; finally the outer sheath becomes constricted and divides; and this process is repeated in each segment.

In their growth, either under natural conditions or by cultivation, the filaments, which are readily destructible, may produce spores which are highly tenacious of life.

Under cultivation the rods may elongate into filaments of great length, forming loops or curves or spirals, and become matted together into a felted mass.

The filaments may continue homogeneous, and show no external signs of division, although the protoplasmic contents often appear to be partially segmented. Then, at more or less regular intervals, appear more highly refractile points, around which the protoplasm appears to coalesce,

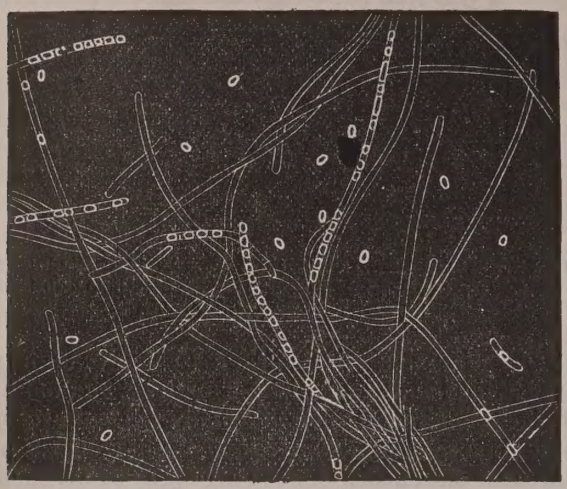

FIG. 69. From a cultivation of bacillus anthracis, after forty-eight hours, showing masses of filaments, some containing spores (which are too closely massed together in the woodcut). From a photomicrograph by Dr. Maddox. ×600 diameters.

forming masses which are at first cylindrical, then oblong, and finally become long, ovoid bodies, enclosed in the outer sheath (*see* figs. 68 and 69). These spores may either escape laterally from the filament, or the filament breaks up into short segments, each containing a central or a terminal spore (*see* fig. 68, *f*); or the filament may gradually dissolve, leaving a mass of spores with some jelly-like substance uniting them (*see* fig. 68, *g*).

However formed, the spore is capable of being preserved, regenerating the bacillus rod, and reproducing the disease.

*Life-history of the anthrax bacillus.* — The bacillus anthracis requires for its growth the presence of a nitrogenised—preferably albuminous—pabulum, and a supply of oxygen. Its vitality is destroyed by a temperature of 60° C., and probably by one even lower when it is in the rod state. Decomposition very rapidly destroys its vitality.

When dry the rods themselves can be preserved a short time (only a few weeks) in an active state. But the life of the spores is not destroyed by short exposure to a temperature of nearly 100° C. in a moist state, and probably still higher in a dry state. They retain their vitality for years, and are unaffected by ordinary changes of climate or temperature. Prolonged boiling, or exposure to a pressure of eight atmospheres of oxygen, destroys their vitality.

ANATOMICAL CHARACTERS.—In cases of malignant pustule *rigor mortis* usually sets in early, and passes off somewhat speedily. The body is often cyanosed, and there is marked hypostasis. The face sometimes appears swollen; petechiæ on the chest and abdomen are not uncommon; decomposition is said usually to set in early; and there may be early *post-mortem* emphysema of the skin of the face and neck.

The blood is generally dark, lake, and tarry, and sometimes peculiarly viscid, and even in the heart it is often uncoagulated. Hæmorrhages, varying in size from a pin's-head ecchymosis to large extravasations, are found in various parts. Ecchymoses beneath the peri- and endo-cardium, and in the cardiac tissue, often occur; also in the muscles, the connective-tissue planes, and the subserous and submucous tissues.

In the lungs there are frequently hæmorrhages; and congestive œdema, with partial collapse, is common. The spleen is usually enlarged, but not invariably; its tissue is dark and pulpy, or may be completely diffluent. The liver is usually swollen, vascular, and somewhat softened, but hæmorrhages are rare. The kidneys are often hyperæmic, and rarely there are extravasations in the cortex or pelvis. The stomach and intestines often present nothing abnormal. In the brain there are frequently scattered, punctiform hæmorrhages, and, rarely, large extravasations in the pia mater.

Such are the general and constant conditions both in the external and internal forms. In the malignant pustule itself the process extends deeply into the subcutaneous cellular tissue; the inner portion is hæmorrhagic, and may be sloughing in the centre; and hæmorrhagic patches radiate into the surrounding tissue (Bollinger), which are extensively infiltrated with a semi-gelatinous blood-stained fluid.

In the *pulmonary* form ecchymosis and gelatinous exudation are sometimes found in the tissue of the neck, especially surrounding the trachea, in the mediastinal glands, and in the lungs and pleuræ. Occasionally the cervical glands may be swollen, and infiltrated with blood; the cellular tissue surrounding them may be œdematous, and sometimes contains large hæmorrhages. In the mediastinum is found a quantity of gelatinous fluid, sometimes blood-stained or mingled with small hæmorrhages. Both pleural cavities usually contain serous fluid, often two or three pints or more. In the pericardium there is a variable quantity of fluid. The bronchial glands are swollen, sometimes greatly so, and may contain extravasations of blood; and there may be large hæmorrhages in their vicinity. The mucous membrane of the trachea and bronchi may be congested, and the seat of small blood-extravasations; they frequently contain frothy blood-stained mucus. From observations which the writer has recently made, there seems to be no doubt that the lesions frequently present in the larger bronchi correspond, both in their anatomical characters and in their relation to the constitutional infection, with the external malignant pustule; and that the virus, having gained entrance by a local infection of the mucous membrane, is conveyed to the bronchial glands, and thence into the blood. The lungs may contain hæmorrhages into their substance, either scattered lobular patches, or more commonly wedge-shaped tracts at the periphery, and diffuse extravasations in the subpleural tissue; but in some cases the lungs appear natural to the naked eye. In this form the abdominal viscera often appear perfectly healthy.

In the *gastro-intestinal* form there is often some blood-stained serum in the peritoneal cavity. The mesentery and retro-peritoneal

connective-tissue are infiltrated with semi-gelatinous fluid. The walls of the stomach, and parts of the intestines, are swollen and congested. In their submucous tissue there may be gelatinous blood-stained fluid or hæmorrhages, which may form solid coagula beneath the mucous membrane. The entire mucous membrane is injected, or merely stained with blood. The intestines contain either blood-stained mucus or watery fluid, more or less mingled with blood. There may also, though much more rarely, be pustular and carbuncular foci in the intestines, which are said to resemble the malignant pustules of the skin.

Microscopic Anatomy.—The most important point in the microscopic anatomy is the presence of the bacillus anthracis in the blood and tissues, either diffused, or forming masses in the vessels and lymphatics. It is unnecessary to describe here other more minute lesions.

Fig. 70. Bacilli from the fluid exuded from the lung in a case of internal anthrax. × about 700 diam. *a*, Red blood-corpuscles. *b* and *c*, Large granular corpuscles from the lung. *d*, Bacilli of various lengths, containing highly refractile granules, or fully formed spores.

Symptoms and Course.—The symptoms of malignant pustule vary greatly with the form of the disease. At least three distinct forms may be considered.

1. *Malignant pustule* or *carbuncle* proper, the form from which the names of charbon and anthrax are derived. Usually it occurs as a primary lesion due to direct inoculation; very rarely secondarily to constitutional infection. The seat is usually either on the face, neck, hand, or arm—namely, those parts most exposed to inoculation.

At first a small red point or pimple appears within a few hours, or two or three days, after inoculation, and may be either painless, or attended by burning or itching. This rapidly extends, so that in a few hours a large red swelling may be formed. Sooner or later a small papule appears at the seat of inoculation, and this vesicates at the summit; the vesicle bursts and discharges a clear or turbid watery fluid, which is often deeply blood-stained. Beneath this there is a dark red spot, which dries up, leaving a central dark brown or black eschar, seated on an angry, red, indurated base. This central eschar enlarges until it may reach the size of a shilling; surrounding it is usually a narrow ring of vesicles, and beyond this a livid red area and extensive brawny œdema. When the pustule is situated on the face, the entire side of the face, head, and neck may be involved in the red œdematous swelling. The lymphatic glands of the part are often greatly swollen. The complete development of the pustule depends on the length of time the patient survives. If recovery ensue, the central black eschar, on the raised, indurated, and inflamed base, may be well-marked at the end of ten days or later.

The symptoms vary much. Even where the local condition is severe, constitutional symptoms may be slight or wanting; or some slight febrile symptoms may be present. But where the general system is involved, and the case takes an unfavourable form, the symptoms may still present great variety. There may be little fever, but great mental depression and physical exhaustion, cold sweats, sometimes diarrhœa, followed by delirium and coma. The mind may be clear to the last, only the increased prostration, embarrassed respiration, and cyanotic condition foretelling the fatal termination. In cases of external pustule, fever, which may be very high, usually predominates, and brain-symptoms are perhaps the rule in fatal cases. Death may occur in thirty or forty hours from the first appearance of the pustule, or be delayed till the fifth or sixth day, rarely later. Healing of the pustule may take place by sloughing, or the eschar may simply separate and the wound granulate. Multiple carbuncles are said to occur after general infection from a malignant pustule, but they appear to be usually merely ordinary furuncles or carbuncles. The mortality in cases of external malignant pustule appears to vary in different outbreaks; probably one in three is a safe estimate.

*Malignant anthrax œdema*, without definite pustule, has also been observed in outbreaks of the disease; it corresponds in the main with malignant pustule, and is usually rapidly fatal. The eyelids are the parts most commonly affected, but it may occur elsewhere.

2. *Internal anthrax* differs greatly from external, and may either be general, having no special lesion; or accompanied by local affections, usually pulmonary, or gastro-intestinal.

The symptoms common to these internal forms of anthrax vary much. The onset is often sudden, but sometimes gradual, preceded by a sense of depression and exhaustion, restlessness, loss of sleep, vague sensations in the limbs, and sometimes cold perspirations. These symptoms may last two or three days before more definite symptoms, but commonly only one or two days, or even a few hours. Whether after premonitory symptoms, or quite suddenly, acute symptoms may set in. There may be vomiting, shivering—amounting to distinct rigor or mere sense of chilliness—headache, and other symptoms common to the onset of many acute diseases. But what is usually most noticeable is extreme physical prostration, often with great mental depression and anxiety, coldness of the extremities, embarrassed respiration, and usually speedy collapse. The temperature is sometimes high, reaching 105° F. or more, but more commonly only slightly elevated; the rectal

temperature being 100° to 101°, whilst the axillary may be subnormal. In some cases delirium occurs early; in others the mind is clear to the end. Vomiting may recur, but is not usually prominent. Amongst occasional symptoms of this form are sensations of numbness or tingling in various parts, particularly of the extremities. Death usually occurs in forty-eight to sixty hours from the onset of acute symptoms, but may be more rapid, or be delayed for five or six days. Owing to the absence of definite symptoms this form, '*anthracæmia*,' has been little studied. More commonly the symptoms assume a more definite character, related either to the respiratory or digestive system.

In the *pulmonary* form the symptoms may more nearly resemble those of acute bronchitis or of pneumonia. At the onset, there are usually some of the general symptoms just described. Some bronchitic sounds are heard over the lungs, especially posteriorly, and there may be patches of crepitation. Occasionally there is sore-throat and swelling of the glands in the neck, but not at all constantly. Cough may be slight or absent, and is rarely severe. But even at this stage there is an amount of prostration and embarrassment of breathing, and tendency to cyanosis, out of proportion to the physical signs. These rapidly increase, the patient takes to bed, there is great prostration, difficult and laborious respiration, cyanosis and collapse, with or without wandering delirium. Death may occur in twelve hours, or be delayed from two to five days. Frequently there are intermissions or remissions, followed by sudden relapse.

In its general features *intestinal anthrax* is somewhat analogous to those already described. But early in the case there appear other symptoms—vomiting, sometimes dysphagia, slight pain, uneasiness in the abdomen, colic, and diarrhœa. The diarrhœa may be from the first bloody, and may continue so. Bleeding from the mouth and pharynx sometimes occurs, and may persist. The general symptoms are those of extreme prostration, cyanosis, and collapse, often without elevation of temperature. Death may occur in twenty-four hours, or be delayed two or three days, rarely longer. There may be swelling of the neck, due to glandular enlargement and infiltration of the cellular tissue; and this may be a marked feature in the case.

It is thus seen that in the internal form of anthrax the greatest variety is observed.

Prognosis.—The prognosis in all these forms is extremely unfavourable. At the same time, it is stated that cases of milder and less fatal character sometimes occur.

Diagnosis.—1. *Of malignant pustule proper.* In the earlier stages diagnosis is very difficult, except in persons who are known to be exposed to contagion. At a later stage the characteristic features of the pustule above described render the recognition comparatively easy; and microscopical examination of the serum contained in the vesicles shows the presence of the bacillus. Moreover, inoculation experiments on guinea-pigs or mice will, if successful, usually readily decide it; but no absolute conclusion can be drawn from failure.

2. *Anthrax œdema* without pustule is extremely difficult to diagnose, except by a known cause of contagion, or the presence of the bacillus in the subcutaneous exudation.

3. *Internal anthrax*, especially the pulmonary form, also presents very few characters by which it can be distinguished, unless there is some known source of contagion. In the later stages, if death is delayed three or four days, and acute inflammatory symptoms set in, the case is likely to be mistaken for acute pneumonia.

4. In *intestinal anthrax* there is also usually a known source of possible contagion, but not in all cases. When, however, the vomiting and purging have set in, the diagnosis from cases of irritant poisoning, especially by antimony or arsenic, must be difficult. In tropical climates the distinction from acute dysentery or from yellow fever may be doubtful.

Treatment.—In malignant pustule, the success of local treatment largely depends upon early diagnosis. As soon as any vesicle or pustule, likely to be due to this poison, is discovered in a person known to be exposed to contagion, active local treatment should be adopted. Excision and cauterisation are the two most effectual remedies. If there is only a small pimple, a free crucial incision, and cauterisation with pure carbolic acid, followed by dressing with carbolised oil or carbolic lint, is the course to pursue. The artificial leech may also be employed with advantage over the site of the crucial incision. When a distinct carbuncle, or rather eschar, has formed, free incision, followed by cauterisation, may be still employed with advantage. The caustics most available are carbolic acid and fuming nitric acid. The former is preferable. The statistics of recovery where this treatment is systematically carried out are highly encouraging.

No other than general treatment appears to be available in the internal form. The fact that carnivora suffer less readily than herbivora suggests the possible benefit of a largely animal diet in persons exposed to contagion. The internal administration of quinine and of carbolic acid are strongly indicated in all forms; and inhalation of air impregnated with carbolic acid might possibly be of value in the pulmonary form. In this form also, as death appears often to be due to compression of the lungs by pleural effusion, evacuation of the fluid should be tried. Stimulants, especially ammonia, ether, and alcohol, are also indicated.

Lastly, and chiefly, prophylaxis is by far the most important point. Stringent regulations with regard to the destruction of the carcases and hides of affected animals would do more to stamp out the disease than any other measure. But as the disease is often imported from distant countries, by means of wool, hair, or hides, which retain the contagion for long periods of time, it is only by the thorough systematic disinfection of these, and the destruction of all the material which is known to be infected, that the disease can be thoroughly prevented. Up to the present time (1881) there is no enactment in England, even in respect of animals known to have died of the disease, which enables anyone to interfere with such disposal of the carcase or the offal as the owner sees fit. It is greatly to be desired that

measures were taken to place the law in this respect on a similar footing with that in Germany and France. W. S. GREENFIELD.

**PUTRID FEVER.**—A synonym for typhus fever. *See* TYPHUS FEVER.

**PUTRID SORE-THROAT.**— Sloughing ulceration of the throat from any cause, such as diphtheria, scarlatina, or syphilis. *See* PHARYNX, Diseases of; and TONSILS, Diseases of.

**PYÆMIA** (πῦον, pus, and αἷμα, blood).—SYNON.: Purulent infection; Fr. *Pyohémie*; Ger. *Pyohämie; Pyämie.*

DEFINITION.—A condition of blood-poisoning which gives rise to fever, accompanied either by severe gastro-enteritis and visceral congestions, or by certain local lesions, which are chiefly venous thrombosis, embolic abscesses in the viscera, acute suppurations of the serous membranes and joints, multiple abscesses in the connective tissue, and eruptions upon the skin. The disease is usually, but not always, sequential to a wound or injury.

ÆTIOLOGY AND PATHOLOGY.— The initiatory symptoms and the anatomical characters of pyæmia are such as point clearly to the introduction of some morbid material into the circulation, and not unnaturally gave rise to the idea, upon which the name of the disease was founded, that this material was pus. Several considerations formerly appeared to favour this belief, amongst which were especially these. Hunter believed that the lining membrane of a vein secreted pus. Now, as cases of pyæmia were found to be very commonly associated with phlebitis, and also with what were thought to be deposits of pus in the viscera, a very simple explanation of the disease seemed to be that the inflamed vein secreted pus, which became mixed with the blood, and was carried by the circulation to some distant organ, wherein, being arrested, it formed the focus of a suppuration.

Hunter observed that in cases in which an injury to a vein proved fatal, the coats of the injured vein were swollen and thickened, and its lining membrane was of an unusually red colour; and he supposed that the fragments of fibrin and the softening clots often found in such veins were the products of an inflammation of their lining membrane, which in the one case was of an adhesive, in the other of a suppurative character. He believed that the coagula generally found in inflamed veins were the means whereby these inflammatory products were prevented from being carried into the circulation, and that if such coagula were not formed, pus secreted by the inflamed vein might be mixed with the blood, and thus distributed.

Hunter, though perfectly familiar with the secondary abscesses of pyæmia, does not seem to have connected them with the introduction into the blood of morbid material from a wound. That these abscesses were the result of an entrance of pus into the blood, and the arrest of pus-globules in the capillaries of the affected organ, was maintained by others, who thus looked upon the process as a mechanical transference of pus-cells from one part of the body to another. These observers supposed that in healthy wounds the entrance of pus into the veins was prevented by the formation of a coagulum, but that if this coagulum were not formed, or became broken down, pus entered the circulation, and gave rise to the secondary abscesses by its arrest in distant organs. This view was supposed to be confirmed by Cruveilhier's experiments, in which he injected mercury into the veins, and found that abscesses were formed in the first set of capillaries to which these veins were distributed, and that such abscesses were formed around a globule of mercury. Thus, if the injection were made into the systemic veins, the abscesses were formed in the lungs; if into the portal veins, they were formed in the liver.

But this explanation of the phenomena of pyæmia was soon found to be insufficient, and also to be incompatible with many facts since ascertained. Cases of pyæmia occur in which there is no primary suppuration from whence the pus could be derived; there is no evidence that the lining membrane of a vein ever secretes pus; the secondary abscesses of pyæmia are not deposits of pus, but true inflammations, and, if examined at their commencement, are found not to be purulent. Again, the first set of capillaries occasionally escape, and the secondary lesions occur in parts beyond them in the order of the circulation; and the position of the abscesses—as, for instance, in the lung, where they chiefly occupy the lower parts of the organ—is not explained by the purely mechanical theory. Besides which, there are the general symptoms of systemic poisoning to be accounted for, and these are sometimes so severe as to kill the patient before any secondary lesions are developed. Experiments upon animals show that the injection into the veins of pus, or any material containing solid particles, is usually followed by the arrest of the solid particles in the first set of capillaries with which they meet, and a consequent obstruction of the capillary circulation; but the result of this capillary obstruction varies according to the nature of the obstructing substance. The injection of septic liquids filtered from solid particles, causes fever and other constitutional symptoms, varying according to the virulence of the poison contained.

An examination of the symptoms of pyæmia will show that it consists of two series of morbid processes, the first series manifesting the general constitutional disturbance due to the systemic poisoning, the second having relation to the secondary lesions thereupon developed. Both analogy and morbid anatomy point to the primary cause of these being the introduction into the blood of an animal poison, which at once gives rise to the first series or the general disease; and we shall see that the secondary lesions are to be accounted for, either by a venous thrombosis, leading to a capillary embolism, or by a stagnation of the diseased blood and the changes which ensue thereupon.

Of the exact nature of the poison which gives to the blood in pyæmia its infective character, we are in ignorance; and it is better to admit this. Our powers of organic analysis are not yet sufficient for the isolation of the subtle but potent poisons upon which so many of the spe-

cific diseases depend; and we do not yet know what it is which gives to a pyæmic clot its infective quality. It is certain, however, that the poison may be either generated within the body or introduced from without, and that there are predisposing causes which render a person peculiarly prone to its generation or reception.

Of predisposing causes, impure air, and especially that kind of impurity which results from the presence of decomposing animal matter, is doubtless the most important. Thus the crowding together of a number of persons with suppurating wounds, neglect in removing the discharges and excretions from sick persons, and imperfect drainage, are causes favouring the development of pyæmia. The puerperal condition is also a powerful predisposing cause. Disease of important excreting organs, whereby effete materials are retained in the blood, also renders a person more liable to pyæmia, as is often observed in cases of Bright's disease; and any great nervous depression (perhaps because of its influence in diminishing excretion) has a like effect. Intemperance, and acute fevers, probably render their subjects somewhat more prone to pyæmia; but it is a mistake to assert that chronic invalids, or persons in weak health, have any special liability to the disease. Children, though by no means exempt from, are somewhat less liable to pyæmia than adults.

Pyæmia, then, is caused by the entrance into the blood of an animal poison, which in the majority of instances originates in a wound, an injury, or a local inflammation; but in some few cases it has been impossible to determine where the disease began. It is especially liable to follow certain diseases and injuries, and is the gravest danger of many operations. Thus, it occurs very frequently after compound fractures, and operations involving the section of a bone; after injuries of the bones of the head, and in connection with acute necrosis of the long bones from suppurative periostitis; also after wounds or injuries of veins; after parturition; in connection with diffuse cellular inflammation, suppuration of the internal ear, and operations upon the urinary organs. Facial carbuncle is a disease peculiarly prone to lead to pyæmia.

Anatomical Characters.—The morbid anatomy of pyæmia reveals two series of changes—the one depending upon the primary infection of the blood, the other upon the secondary effects of this. When the blood is very profoundly infected, the results of general blood-poisoning are often all that can be found; the patient dies before the secondary affections can be produced. When the poison is smaller in quantity, or not much in excess of the eliminative powers, the secondary lesions predominate; but in most cases changes of both kinds are found.

The wound, or the tissues at the site of the primary disease or injury, from whence the poison has entered the blood, are found in various conditions. There is often, but not always, suppuration present, and the wound is bathed in foul and unhealthy pus; or the wound may be dry, and discharging only a little thin ichor; or the cellular tissue may be infiltrated with sero-purulent fluid. The veins in the neighbourhood of the diseased tissues are often found blocked with coagula, extending a variable distance along their channels, and in different stages of disintegration. These clots may be soft and dark, or firm and adherent to the lining membrane of the vein, and partially decolourised; or they may be broken down in the centre to a reddish-yellow pulpy material, consisting of disintegrated fibrin. Sometimes the whole clot is thus softened, and the fragments of fibrin have been partly carried away into the circulation. Occasionally, but rarely, the clots contain real pus; but the puriform material found in the vessels is usually only broken-down fibrin, and the *débris* of cells.

An abscess may, however, open into a vein, and thus pus may gain a direct entrance into its channel; in such a case a coagulum, consisting of a mixture of pus and blood, is found in the vessel, and we have a true purulent clot. Softening thrombi are found with especial frequency in connection with injuries and diseases of bone, as, for instance, in the sinuses of the dura mater after bruising of the cranial bones, or in consequence of caries of the bones of the ear; or in the veins of an unhealthy stump, in which there is inflammation or necrosis of the bone.

But it may be certainly affirmed that many cases of pyæmia occur in which no thrombi are found, and in which the most careful examination fails to detect any morbid condition whatever of the veins. It is necessary to point this out, because it has been erroneously asserted by some that phlebitis is an essential process in the disease. It is to be observed also that the presence of pus is not a necessary element in the causation of pyæmia, as was once supposed; well-marked cases have been seen in which there has been neither wound nor suppuration for its origin. When a wound does exist, however, it is usually found in an unhealthy condition, and in this may probably be found the explanation of the spread of pyæmia by contagion. Healthy granulations do not allow the entrance of septic matter into the blood; a wound may be bathed with fœtid fluids of a most poisonous character, and yet none may be absorbed, as has been proved experimentally by Chauveau; but if the surface of the wound becomes unhealthy, the granulations no longer present a barrier to the absorption of poisonous fluids. This is probably due, as Mr. Savory has suggested, to the dialysing property of animal membranes. If, then, the secretions or exhalations of an unhealthy wound come in contact with another secreting surface, an unhealthy action may thereby be set up on that surface, producing a condition favourable to the absorption of septic material. This explains the prevalence of pyæmia where a number of persons with open wounds are crowded together. A similar condition of wound may also be induced by neglect of other sanitary precautions, especially by the presence of decomposing animal matter, and the escape of sewer-gas into the air surrounding the patient.

In cases of acute pyæmia the morbid changes found *post mortem* are chiefly congestion and softening of the viscera, local stagnation and extravasation of blood, and a general blood-staining of the tissues—conditions indicating profound changes in the state of the blood. In what these changes consist we are at present ignorant; but

usually the blood contains an excess of leucocytes, and its fibrin is diminished in quantity and lacks contractility.

When the disease is not of this acutest form, but is of longer duration, there are developed those secondary lesions which are especially characteristic of pyæmia.

Most notable and commonest among these are the so-called 'secondary deposits' or 'secondary abscesses' of pyæmia. These are found most frequently near the surface of the viscera, and are the result of the obstruction of the terminal branches of the vessel supplying the part with blood. This obstruction is followed by engorgement and extravasation, by inflammation, and by rapid necrosis or suppuration. It is necessary more fully to describe this process before giving an account of the morbid anatomy of individual organs thus affected. The obstruction may be caused in several ways.

1. It may be embolic. A portion of a disintegrating clot may be carried into the circulation, until it meets with an artery too small to allow its transmission, or with the first set of capillaries in its route, wherein it becomes arrested. In this way a portion of the organ is deprived of its arterial blood-supply, and in consequence of the absence of the *vis-à-tergo* of the heart, regurgitation takes place from the veins into the capillaries, and even into the terminal arteries, giving rise to a venous engorgement of the affected region. The nutrition of the capillaries being interfered with by the lack of arterial blood, their walls become altered or necrosed, and extravasation of blood takes place, the area of extravasation corresponding with the part supplied by the obstructed vessel. At the same time the vessels of the tissues immediately surrounding the obstructed region become dilated, and so form a zone of intense hyperæmia. So far, this process is only what occurs in any case of embolism (as, for instance, when minute fragments of fibrin are detached from an inflamed mitral valve), but the importance of the process in pyæmia depends upon the changes which subsequently occur. Now the changes which occur in the tissues of a part the seat of embolism depend upon the character of the embolus. If the embolus come from a part which is gangrenous, gangrene will usually occur in the tissue to which it is carried; if the embolus be purulent, or come from a suppurating region, 'then the effect is a suppuration in the part implicated. This suppuration, however, is complicated with the embolic passive hyperæmia we have above described, so that the suppuration is incomplete, and consists rather in rapid breaking-down of the tissues than in the formation of a large number of pus-cells, while the characteristic deep-purple congested zone around the affected spot is much intensified. Some describe this as a true sphacelus of the affected part, but there is no necrosis, and no foul decomposition of the patch affected in the suppurative form of embolic inflammation. Lower degrees of inflammatory quality in the embolic clot induce similar but slighter inflammatory conditions, additional to the states described as due to the mechanical obstruction.' There are all gradations among such degrees (Wilks and Moxon).

If, then, the embolus originate in a wound infected with the pyæmic poison, it sets up an unhealthy inflammation and rapid disintegration of the tissues wherein it is arrested. The important difference, therefore, between pyæmic and other embolism consists in the fact that the pyæmic embolus is composed of *infected* clot. Virchow and others have maintained that this is the sole mode of production of the secondary pyæmic formations. This is incorrect, for, although such formations doubtless often have such an origin, they may also arise in a different manner. The embolic theory will not account for cases in which the first set of capillaries in the order of the circulation from the seat of injury escape, and secondary deposits are found in other organs beyond; as, for instance, where they occur in the liver after an injury of the head, and the lungs are not affected. Neither does this theory explain the cases in which the joints only are affected, as in connection with gonorrhœa or scarlatina; nor are the chronic cases in which only superficial abscesses occur thus explicable. It must be remembered, too, that the lesions in the lungs are found chiefly in the inferior parts of the organ, which is not what would be expected were their origin always embolic.

2. The capillary obstruction may be caused by a local stagnation depending upon the poisoned state of the blood. The infection of the blood interferes with the normal interchange between this fluid and the tissues, and produces a tendency to coagulation in the minuter vessels. This coagulation is especially prone to occur in organs or parts of organs already congested, for where the circulation is slow the impurity will be the greater. In this way the greater frequency of the secondary lesions in the lower than in the upper part of the lungs is accounted for. When this form of thrombosis has taken place, the part so affected is in a condition similar to that above described as due to embolism, and the same series of changes ensues. It must be remembered, also, that the impurity of the blood interferes with the nutrition of the vessels, which thus easily allow of the extravasations that are so frequently found, not only in the viscera, but on the surface of the skin and mucous membranes.

It is more difficult to explain the occurrence of the joint-affections, and the especial vulnerability of certain organs to the secondary inflammations of pyæmia. All that can be said on this part of the subject is that the poison of pyæmia selects certain organs and tissues wherein to expend itself, just as that of rheumatism, syphilis, or typhoid fever does.

The *lungs* are usually congested throughout, and are very prone to the secondary lesions. These are found chiefly near the surface and in the lower and posterior portions, and consist, in the early stage of the process, of small extravasations and patches of congestion; the minuter branches of the pulmonary artery are herein found plugged with coagulum; and hæmorrhage, or inflammatory exudation, has taken place into the surrounding tissues. Thus we have a patch of pulmonary hæmorrhage, or of lobular pneumonia. Later on, the centre of this area of consolidation is found in a state of necrosis, and

its circumference surrounded by a ring of intense congestion. The process of disintegration occurs with great rapidity, and the central portion of the nodule may be found within forty-eight hours of the first symptom of pulmonary mischief, broken down into a soft yellow puriform material, or even containing true pus. The nodules are perfectly circumscribed, and average in size about that of a hazel-nut, though they may be smaller or larger. On section, they are seen to consist, in the centre, of a cavity filled with pus or puriform *débris*; surrounding this is an area of pneumonic consolidation, the circumference of which is formed by a narrow ring of intense congestion. The surrounding lung is usually simply congested, or it may even be natural in appearance. An examination of the early stages of these changes shows the first step in the process to be a blocking of the minute branches of the pulmonary artery; and this may occur either from a local coagulation, or by the transference of a portion of clot from some other part, that is to say, it may depend either upon thrombosis or upon embolism; but in whichever manner it originates it is followed by a rapid exudation into, and disintegration of, the portion of lung to which the blocked vessels belong. It has been pointed out that these changes take place chiefly in parts of the lung near the surface. The result of this is that the *pleura* becomes involved in the inflammation, and those nodules which have reached the surface of the lung are coated with a patch of lymph, which may subsequently become part of a more general pleurisy. Or one or more of the abscesses may burst into the pleura, when a rapid effusion of sero-purulent fluid takes place into its cavity.

Pleurisy may, however, occur independently of the lung-disease; and in this case, also, the effusion becomes rapidly purulent. In the early stage of the disease numerous subpleural ecchymoses are frequently found. Pleurisy is especially prone to occur in those cases of pyæmia originating in caries of the bones of the ear; and in children thus affected is often the first symptom of the pyæmic infection.

The *heart* is liable to be affected by the same kind of embolic abscesses as are found in other organs. They occur most often in pyæmia from acute necrosis, in young persons. In the early stage small spots of congestion, due to the plugging of small arteries, are found both on the surface and in the substance of the heart, and also beneath the endocardium. Later on, small cavities containing pus or puriform fluid, and surrounded by a zone of congestion, are found in the walls of the organ. These abscesses are sometimes very numerous, and may occur in any part of the organ; they may open on the surface or into the cavity of the heart; the muscular tissue around them is softened and broken down. The *pericardium* may thus become inflamed from the contiguity of an abscess in the wall of the heart; but, as with the pleura, pyæmic pericarditis may occur independently of such an origin, and in either case the effusion rapidly becomes purulent. The same process may lead to inflammation of the endocardium.

The *brain*, although less frequently the seat of pyæmic abscess than many of the organs, may be the sole organ affected by the secondary lesions; and it not uncommonly happens when this is so, that the general symptoms are unusually slight. Small extravasations are often found in the subarachnoid tissue. Circumscribed softening ending in abscess is most frequent in the white matter of the brain. It commences as a patch of red softening, due to obstructed vessels, which subsequently changes to a reddish-yellow pulp, or to greenish pus, enclosed by a more or less defined wall. Such an abscess may run a very chronic course, and is then found enclosed in a cyst of connective tissue.

The *peritoneum* is occasionally found acutely inflamed, its surface vascular and coated with lymph or pus; in other cases the membrane is spotted with numerous ecchymoses. Peritonitis may also be set up by secondary abscess of the liver making its way to the surface, or even bursting into the abdominal cavity. In some cases of strangulated hernia, death takes place with great rapidity after operation, from absorption of septic fluid which has escaped from the sac into the abdominal cavity. In addition to the usual visceral conditions, the peritoneum is then found vascular, and slightly coated with commencing exudation.

In acute cases of pyæmia the *alimentary canal* is often found in a state of catarrhal inflammation, or of intense congestion, accompanied by small spots of hæmorrhage. The intestinal flux is probably eliminative, for in animals which recover after the injection of septic matter into the blood, diarrhœa is usually a prominent symptom.

The *liver* is, next to the lungs, the organ in which secondary deposits are most frequently found in pyæmia. In acute cases the organ is found congested, softened, and swollen; it has lost elasticity; and its texture on section is confused and clouded. Secondary abscess is, of course, especially prone to occur in connection with dysenteric and other lesions of the bowel, but is also found in cases of general pyæmia, originating in any part of the body. It commences by plugging of the portal capillaries, leading, as has been explained with regard to the lung, to congestion and stagnation of blood in the affected portion; the nutrition of this portion being thus interfered with, necrotic changes soon commence, and the infective character of the clot gives the start to destructive inflammation. The capillaries surrounding the diseased area dilate, and inflammatory exudation occurs into its circumference; at the same time central disintegration is rapidly going on; and in a short time we find a purulent collection, surrounded by a zone of exudation and congestion. Occasionally these abscesses run a more chronic course, and become encysted; and it seems probable that the tropical hepatic abscesses, which often attain a large size, have an embolic origin, connected with the ulceration of dysentery, and may thus be classed with pyæmic suppurations. It must be remembered that pyæmic abscess in other parts is not always acute. Sometimes, but more rarely, hepatic abscess originates in embolism of the hepatic artery, in which case the suppurations are usually smaller and more scattered.

The *spleen* may be simply swollen and soft, or may contain abscesses precisely resembling those

described in the liver; the same may be said of the *kidneys*.

Inflammation of the *bones and joints* may be either the cause or the effect of pyæmia. The frequency with which pyæmia originates in diffuse periostitis and osteo-myelitis is well known. In such cases the heart and kidneys are especially liable to be the seat of secondary deposits, and the disease is generally of a severe form. The bone is found stripped of its investing periosteum, and separated from it by a quantity of pus. The surface of the bone is bare, and of a yellowish-white colour; the medulla is usually also inflamed, and is tumid and vascular, or it may be infiltrated to a varying extent with purulent fluid. Sometimes, as after amputation, the medulla is the part chiefly affected, and the inflammation extends to a greater distance along the interior than the exterior of the bone. These changes may also be secondary effects of pyæmic infection from disease of other parts. The disease is usually arrested at the epiphyses, but it may spread to the adjacent joints. The joint-affection most commonly found in pyæmia is an extremely rapid suppuration. In no other kind of joint-inflammation does the destruction of the tissues involved so quickly take place. The cartilages may be found extensively ulcerated, and the joint filled with purulent fluid, within forty-eight hours of the first symptom of inflammation. At first the synovial membrane is swollen and vascular, and the joint distended with a slightly turbid fluid. This fluid usually quickly becomes purulent, and superficial erosions and softening of the cartilages occur, soon leading to extensive ulceration and irreparable destruction of the joint.

In 'gonorrhœal rheumatism,' which some consider a mild form of pyæmia, the effusion is not generally purulent, and the same may be said of the joint-swellings occurring in women with other purulent discharges. So again, scarlatinal pyæmia (in which the infection takes place from the ulcers in the throat), though often of a severe kind, is not infrequently attended with merely serous effusions into the joints, from which complete recovery takes place.

The *muscles and cellular tissue* are often invaded by pyæmic abscesses, and by inflammatory exudations and extravasations of blood. In the muscles the process commences in the cellular tissue between the fibres. Abscess in the intermuscular septa and the subcutaneous cellular tissue is often the result of the more chronic forms of pyæmia.

The *skin* in many cases of pyæmia is found more or less jaundiced; petechiæ and sudamina are not uncommon; and sometimes a pustular eruption is seen. Patches of livid congestion also occur, some of which may have passed into gangrene in the centre or where subjected to pressure.

The morbid anatomy of *other organs* shows that secondary abscesses may occur in almost any situation; among the less rare may be mentioned the eye, the prostate gland, and the testicle.

Before leaving the consideration of the pathology of pyæmia, it is necessary to allude to the connection which is supposed by some to exist between bacteria and this disease. It is said by Dr. Sanderson that great numbers of microzymes are found in the blood and inflammatory exudations of animals suffering from acute infective fever, produced by inoculation of septic matter. Others (Wilks, Moxon, Goodhart) have failed to find bacteria in the blood of living cases of pyæmia, though they may be found in great numbers after death. The committee appointed by the Pathological Society 'to investigate the nature and causes of those infective diseases known as pyæmia, septicæmia, and purulent infection,' state that, 'although bacteria of various forms were found in the blood in a number of cases, they could not be found in all the cases, nor were they discovered constantly in those cases where at one or other time they were present' (*Trans. of Path. Soc.*, vol. xxx. p. 44). Our knowledge of these organisms is at present insufficient to enable us to speak certainly of the part which they play in connection with this disease, but the investigation is one of great interest and importance. *See* Bacteria; and Micrococcus.

Symptoms.—A patient who has become the subject of pyæmia, often appears to be progressing quite favourably up to the moment when the disease attacks him; in other cases there may have been loss of appetite, depression, or restlessness, for a day or two, with perhaps some little elevation of temperature. The wound, if there be one, has probably assumed an unhealthy appearance: its surface may be dry, or the discharge may be thin and offensive, the healing process is arrested, and recent adhesions may give way. The attack, however, is usually sudden, and is almost invariably ushered in by a severe rigor, followed by sweating. The rigors are of variable duration and frequency, but are usually severe while they last; occasionally they recur with such regularity as to simulate ague. The patient at first may not feel particularly ill, but he rapidly becomes so. Pains in the limbs and general uneasiness occur; the pulse becomes weak and rapid; fever, of an intermittent type, commences, with its usual accompaniments of loss of appetite, restlessness, and thirst. The tongue becomes dry and brown; diarrhœa frequently occurs; and the skin and conjunctivæ may become jaundiced. If the infection be profound, the prostration is extreme; there is usually cough and diarrhœa; muttering delirium sets in early, and soon leads to unconsciousness and death. In such cases the blood-poisoning kills before there is time for the development of any secondary lesions.

In less acute cases local symptoms soon begin to appear. A day or two after the initial rigor pain and swelling of one or more joints occurs, or a subcutaneous abscess forms, or discolourations or pustules are seen on the skin. Cough, attended with rusty expectoration, is common; the respirations are rapid and shallow; there is pain in the chest; and perhaps dyspnœa or orthopnœa from pleuritic effusion. Meanwhile the depression increases; jaundice frequently comes on; and the face assumes a pinched and anxious expression. There is, moreover, often a peculiar sweet smell about the

patient, somewhat resembling that of diabetic urine. The rigors mostly cease after the first few days, but the temperature usually maintains a remittent character. The skin shows a tendency to slough on very slight pressure, so that troublesome bed-sores easily form; and patches of superficial gangrene sometimes occur without any such provocation. Vomiting is not a symptom of frequent occurrence; and though there is usually no appetite, yet nourishment is often freely taken and digested. The cerebral symptoms are not usually severe, unless there be secondary lesions in the brain; but there is often a low form of delirium; and towards the end the patient usually becomes unconscious, and passes the evacuations unknowingly. Death may occur from general exhaustion; or from the severity of some local lesion, as, for example, from pericarditis, pleurisy, or cerebral abscess.

The duration of the disease is, in the majority of cases, from a week to ten days. It may, however, prove fatal in forty-eight hours; or, on the other hand, it may be prolonged for weeks or even years.

Pyæmia may commence at any stage of disease or injury; the most common period of invasion is during the second week.

Certain peculiarities must be noted concerning some forms of pyæmia, for which no satisfactory explanation can be given. For instance, in acute necrosis pyæmic symptoms are frequently seen almost from the commencement of the disease, and yet these cases of pyæmia are sometimes of very long duration. Such cases, though severe, are among the least fatal; and when death does take place, abscesses are usually found in the heart and kidneys. The pyæmia arising from disease of the internal ear is especially prone to lead to pleurisy, which is often the prominent condition throughout. That variety of pyæmia associated with gonorrhœa and with scarlatina tends especially to affect the joints, and these are often the only parts invaded; but this joint-inflammation is very different from that which occurs in the course of other cases of pyæmia, for the effusion is generally slight, and does not become purulent. Such joint-affections are not uncommon after parturition. There is, moreover, a chronic form of pyæmia which is not very rare, and which resembles the acute and typical form 'in the formation of widely-dispersed, shapeless collections of pus or allied inflammatory matter; in the probability that these formations are due to some infection of the blood by the entrance of diseased inflammatory products; and often in the occurrence of rigors and profuse sweatings, of phlebitis, and inflammations of joints. But they differ from the acute type in that their course extends, continuously or with relapses, over many weeks or months, and is often free, at least in its later stages, from all severe general disturbance of the health, and from nearly all risk of life' (Paget). 'The election of a single tissue, and the observance of an uniform method of disease, in the secondary affections, are characteristic of chronic rather than of acute pyæmia. They are very marked in some of the cases that follow parturition, in which women suffer for many weeks with a succession of abscesses in the subcutaneous connective tissue of the limbs, and usually (after long suffering) recover completely. Such cases are also sometimes seen in men' (Paget).

Occasionally, also, cases are seen of unusual duration, in which there are severe constitutional symptoms throughout. For the particulars of the following remarkable case of pyæmia after parturition, in which severe symptoms extended over a period of five months, the writer is indebted to Mr. Pollock, who attended the patient with Sir Thomas Watson, Dr. Babington, and Mr. Headland:—

Lady P. was confined on July 9, 1849. A few days after confinement there was slight phlegmasia dolens of one leg, which passed off in a fortnight. On August 8, she was attacked with violent rigors, fever, and sweating, with rapid pulse and great anxiety of countenance; in fact, with well-marked symptoms of severe pyæmic fever. The rigors and sweatings continued with great severity for fifteen days, when she became slightly better, and was removed into the country. Early in September there was a recurrence of the symptoms, and these continued with varying severity till October 29, when she was attacked with acute pleuro-pneumonia. This subsided, but the rigors continued, and, in the latter part of November, Dr. Watson diagnosed consolidation and secondary abscess of the lung. A few days afterwards a quantity of pus was expectorated, and this was followed by rapid improvement, and eventually by complete recovery, the patient being quite well when the present article was written.

Diagnosis.—The chief difficulties in the diagnosis of pyæmia arise from the occasional prominence of some local symptom, which masks the general disease. Probably the most common mistake is to regard a case of acute necrosis, with early joint-symptoms and rigors, as one of rheumatism. Herein, however, there is an absence of the acid perspirations and the coated tongue of rheumatism; the rigors are more frequently repeated; and a careful examination will reveal mischief about the shaft of the bone as well as in the joint. When the chest-affection is severe, as in the pleurisy of children with disease of the internal ear, it may be looked upon as the primary disease; but a sudden attack of pleurisy occurring in anyone with otorrhœa, should at once give rise to a suspicion of pyæmia. The later stages of the disease may present some resemblance to typhus or enteric fever, but the history would give marked distinctions; and in the majority of cases the diagnosis is sufficiently easy at any period of the disease.

Prognosis.—The prognosis in all acute cases of pyæmia is very unfavourable. The great majority die, sooner or later; either early in the disease, from the general blood-poisoning, or subsequently, from the gravity or exhausting character of the secondary lesions. Yet some few do undoubtedly recover, and these are they in whom the viscera escape, and the disease expends itself upon the surface of the body, or runs a chronic course without involving vital organs. Puerperal pyæmia is less fatal than surgical.

Treatment.—The unsatisfactory results of the treatment, and the great mortality of pyæmia, are the strongest reasons for taking every pos-

sible precaution for its prevention. A consideration of the causes which predispose to, and favour the development of, the disease, will suggest certain prophylactic measures. Of these none are more important than to surround a patient who is suffering from an injury or operation, with an abundance of fresh air, and to carefully guard him from the exhalations of decaying organic matter. Overcrowding, and especially the accumulation of cases in which suppuration is going on, should be avoided. The careful drainage of wounds is of the greatest importance; for whether germs be admitted or not, one obvious way of preventing decomposition in a wound is to take care that nothing is left therein to decompose. The wound should be kept scrupulously clean, and the dressings changed sufficiently often to prevent the discharge becoming foul. Antiseptic dressings are very useful in this respect, and, whatever other advantages they may or may not possess, it is certainly desirable to apply to a wound a dressing which prevents the decomposition of the discharge, and the contamination of the surrounding atmosphere (*see* ANTISEPTIC TREATMENT). The integrity and functional activity of the chief excreting organs should be inquired into in all cases of operation or injury, so that the accumulation of effete material in the blood may be guarded against; and it should be remembered that the sudden change of condition that an operation or accident frequently involves, may in itself seriously interfere with the action of the bowels and kidneys.

When, however, pyæmia is developed, it must be admitted that treatment has over it but little control. The chief indication is to combat the extreme depression which is always present, and to endeavour so to support the patient that he may be able, if vital organs escape, to pass through the series of severe local affections that may be anticipated. The satisfactory results obtained by Professor Polli, of Milan, from the administration of sulphurous acid to animals into whom putrid injections had been made, have not followed the use of this remedy in the human subject; yet there is reason to think it has sometimes done good, and to encourage us to give the sulphites in, at least, some of the more chronic cases. Probably, however, the most useful medicine is quinine, which sometimes produces marked benefit; it should be given in full and frequently-repeated doses.

The local affections must be treated on general principles. The secondary abscesses should be opened early; and this is especially important with regard to the joints, from whence the pus should be evacuated directly we are sure of its existence. When the infection appears to originate in the inflammation of an accessible vein, the vessel should be divided between the heart and the inflamed part, in the manner recommended by Mr. Henry Lee. If symptoms of pyæmia occur in connection with inflammation of a long bone, the question of amputation must be considered; and there are strong reasons for believing that by this measure the disease may sometimes be arrested. During the progress of the disease bed-sores must be carefully guarded against, and the diet studiously adjusted to the daily needs; in fact, much will depend in this, as in the majority of serious disorders, upon careful nursing, judicious feeding, and the observance of every hygienic precaution.

J. WARRINGTON HAWARD.

**PYELITIS** (πύελος, a vessel).—SYNON.: Fr. *Pyélite*; Ger. *Nierenbeckenentzündung*.—Inflammation of the pelvis of the kidney. *See* KIDNEYS, Diseases of.

**PYLEPHLEBITIS.**—Inflammation of the branches of the portal vein, often associated with thrombosis. *See* PORTAL THROMBOSIS.

**PYLORUS, Diseases of.**—The muscular fibres of the stomach are disposed in three layers. Immediately below the peritoneum they are placed in a longitudinal direction; these are continuous with those of the œsophagus, and pass downwards over the organ, being continued to the duodenum; they are collected into bands of considerable thickness along the curvatures, especially the upper, and become stronger as they approach the pylorus. The middle layer surrounds the whole of the stomach, but to the left of the cardiac orifice the fibres are thin, and are replaced by those that are oblique. At the pylorus they form a thick band or ring, acting as a sphincter to the opening into the duodenum. The oblique fibres are continuous with the deep layer of the muscular coat of the œsophagus. They arch over the fundus, but are quite lost towards the opposite end of the organ. The muscular coats of the stomach are formed of involuntary or unstriped fibres, being composed of elongated fibre-cells, which are united together by a sparing amount of connective tissue. The connective tissue is much thicker and stronger at the pylorus than at other parts of the organ, giving a great amount of firmness and strength to that region. The mucous membrane is also thicker, and the gastric tubes are wider than elsewhere. Most of these contain gastric cells, but are lined with conical epithelium to a greater depth than in the more actively secreting regions. Some anatomists have stated that in the human stomach, as in many of the lower animals, there are no pepsin-forming cells in this part; but in numerous cases the writer has been able to obtain an active artificial gastric juice from the mucous membrane covering it.

The pylorus participates in the diseases of the stomach, which are fully described under that heading (*see* STOMACH, Diseases of). As the outlet of that organ, however, the patency of the pylorus is of so great importance that its obstruction will be specially considered here.

**Pylorus, Obstruction of.**—An obstruction to the passage of the contents of the stomach into the duodenum is not unfrequent, and may arise from very different pathological conditions. 1. The most common of these is the presence of a *cancerous* tumour at the pyloric end of the stomach. It usually surrounds the opening, and rarely spreads to the intestines. On microscopical examination the muscular fibres in the vicinity of such tumours are sometimes found to be hypertrophied, the contractile fibres being enlarged and increased in number. More generally

the cells are atrophied, although to the naked eye the muscular bundles may seem to be enlarged; sometimes the contractile cells are faint and small, in other cases they are reduced to fibrous tissue, and no trace of the original structure can be discovered. This condition of the muscular tissue furnishes us with an explanation of the fact, that there is often great obstruction to the passage of the gastric contents into the duodenum, where the pyloric opening seems only partially constricted; and it is to this loss of muscular contractility, and not to the mere narrowing of the opening, that we must look in order to understand how in many cases the stomach becomes dilated from its incapacity to discharge its contents. 2. The pylorus is sometimes narrowed by *fibroid thickening* of the submucous tissue. This morbid change may be confined to the opening only, or it may extend some distance from the part chiefly affected, producing a hard, leathery condition of the coats. The same effect, although to a less degree, is produced by an obstruction of this kind as by cancer. The muscular bundles become hypertrophied, their contraction being embarrassed by the tough, fibrous tissue that surrounds and separates them. 3. The pyloric opening may be obstructed by an *ulcer*. This may arise either by its cicatrix producing a contraction, which leaves only a small opening through which the food has to find its way; or, on the other hand, the muscular coat may have been destroyed by the ulceration, and the stomach may, in this way, be unable to force onwards its contents. 4. The pylorus or the duodenum may be constricted by the pressure of a *tumour*. Cases have occurred where a cancerous gall-bladder has compressed these parts, but more generally the pressure is caused by glands enlarged by malignant disease. In a case which came under the notice of the writer, the opening was constricted by enlarged scrofulous glands occurring in a man affected with phthisis. 5. *Adhesions* may form between the duodenum or pylorus and the neighbouring parts, and in this way they may produce a difficulty in the passage of the food from the stomach. A curious case fell under the writer's notice in which a man received a severe blow on the abdomen, which was followed by symptoms of obstructed pylorus. On *post-mortem* examination a portion of the upper part of the small intestine was found to be bent upon itself by the exudation of lymph into the mesentery close to its edge.

Effects.—The effect of any considerable obstruction at the pyloric opening is to produce a greater or less degree of dilatation of the stomach. The most prominent symptom is vomiting, occurring at irregular intervals, and usually several hours after taking food. Along with this we find heartburn, and other signs of indigestion; and a gradual loss of flesh and strength. The treatment must be directed to these effects and symptoms. *See* Stomach, Diseases of—*Dilatation*.

Samuel Fenwick.

**PYONEPHRITIS.**—Inflammation of the kidney, leading to the formation of abscess. *See* Kidney, Diseases of.

**PYOPNEUMOTHORAX.**—A morbid condition of the pleural cavity, in which it contains both pus and gas. *See* Pleura, Diseases of.

**PYRENEES.** *See* Bagnères-de-Bigorre; Eaux Bonnes; Eaux Chaudes; and Pau; and Climate, Treatment of Disease by.

**PYREXIA** (πῦρ, fire, and ἔχω, I have).—This word is commonly employed as a synonym for fever; but it is applied by some pathologists to elevation of the body-heat from any cause. *See* Fever; and Temperature.

**PYRMONT**, in Germany.—Iron waters and salt waters. *See* Mineral Waters.

**PYROMANIA.**—A name which has been given to insanity when the patient manifests a propensity to incendiarism. Its claim to be regarded as a special form of insanity has not been established. *See* Insanity, Varieties of.



**PYROSIS** (πυρόω, I burn.)—Synon.: Waterbrash; Fr. *Pyrosis*; Ger. *Sodbrennen*.

Description.—Patients affected with waterbrash experience a severe spasmodic pain at the epigastrium, which is often attended with a feeling of constriction, and after the lapse of a few minutes relief is afforded by the rejection of a quantity of watery fluid. The fluid is usually tasteless, without any smell, and seldom amounts to more than two or three ounces. Microscopically, it presents numerous epithelial scales from the mouth, and the writer has also found in it some gastric cells. It is neutral to test-paper, is not albuminous, and in one case in which he carefully examined it, it gave a dense precipitate with baryta, and a bulky precipitate with nitrate of silver, soluble in nitric acid. Frerichs remarked that the fluid contains sulphocyanuret of potassium, and therefore believed it was only saliva. But it is evident that it can scarcely be possible to obtain it entirely free from the salivary secretion, and therefore no great weight can be allowed to the observation. Waterbrash is not necessarily connected with structural disease of the stomach, for the majority of those who suffer from it recover perfectly. Again, in some cases the fluid rejected is evidently only saliva. In some persons affected with disease of the pylorus, the rejection of a tasteless fluid takes place, but this is neither accompanied nor preceded by pain.

Pathology and Ætiology.—Much difference of opinion has been expressed as to the source of the fluid which constitutes waterbrash. It has been referred to the œsophagus, stomach, duodenum, and pancreas. The pancreas seems unlikely to be the organ from which it comes, for the fluid is unmixed with bile, and we should imagine a more violent effort would be required to reject it from a part so distant from the mouth. Again, the œsophagus is very intolerant to any collection of liquid in it, and it would only be by a spasmodic closure of the cardiac orifice that such an accumulation could occur in this tube. As regards the stomach, it seems improbable that the larger and more active end of this organ should be the source of the liquid, for any irritation should produce an acid, not a tasteless, fluid. At the pyloric end, however, there is a mass of tubes, lined

chiefly with conical epithelium, whose office it is to secrete mucus, and as the only organic change that has been found along with waterbrash is thickening at the pylorus, we may reasonably conclude that this is the part whence the fluid is ordinarily derived.

Waterbrash seldom occurs before puberty; it affects females more than males; and chiefly presents itself in persons of middle age. It is more prevalent in some countries than in others; and is most general amongst those who subsist on food of a coarse and indigestible kind.

Treatment.—All sources of gastric irritation should be removed, such as every form of insoluble or irritating food. Astringents, with or without opium, are the most efficacious remedies. They should be given in the intervals between digestion, so that they may act directly on the mucous membrane. Lime-water, bismuth, zinc, or other mineral astringents, or vegetable astringents, such as kino, krameria, logwood, or tannin, may be preferred; but, on the whole, the writer has found the oxide and nitrate of silver the most efficacious. Unless there be some objection to it, opium may be combined with the astringents, as it both lessens the pain and seems to restrain undue secretion; or mercurial alteratives may be given, as their use is often attended with the best results. Samuel Fenwick.

**PYTHOGENIC FEVER** (*πύθω*, I rot, and *γεννάω*, I beget).—A synonym for typhoid fever. *See* Typhoid Fever.

**PYURIA** (*πύον*, pus, and *οὖρον*, the urine).—A name for a condition of the urine in which it contains pus. *See* Urine, Morbid Conditions of,

# Q

**QUARANTINE** (*quaranta*, Italian, forty). Synon.: Fr. *Quarantaine*; Ger. *Quarantäne*.

Definition.—The enforced isolation of individuals and certain objects coming, whether by sea or by land, from a place where dangerous communicable disease is presumably or actually present, with a view of limiting the spread of the malady. The objects liable to quarantine include—on the assumption of their being apt to carry the contagion or infection of the disease—the luggage and personal effects of the individuals isolated, certain articles of merchandise, and ships; and, in land quarantine, carriages and other vehicles. Sometimes entire communities and districts are subjected to quarantine.

History.—According to systematic writers, quarantine had its origin in the fourteenth century, when the principle of isolation, applied from a much earlier period to leprosy (*mal de St. Lazare*), began to be extended to pestilential diseases; and leper hospitals (*lazarets*), then falling into disuse from the decline of the disease, were converted to (as we should now say) quarantine uses. To this day quarantine establishments retain the name significant of their original purpose—namely, *lazarets*. Fodéré suggests that the period of forty days during which it was customary formerly to enforce isolation, and from which the designation *quarantine* is derived, had its source in the teaching of Hippocrates, who, according to Pythagoras, attributed a special virtue for the completion of many things to that period of time. The methodical establishment of quarantine dates from the sixteenth century, when the earliest doctrines of contagion, in the original acceptation of the term, were also formulated. These doctrines, fantastic though, in many respects, they now appear, still largely adhere to the practice of quarantine. Plague, as we now understand the word (*see* Plague), was the disease against which quarantine was chiefly, indeed almost wholly levelled, until the beginning of the present century; and the system is so imbued with the notions formerly held as to this malady, that it has been found impossible to disembarrass it from them, in endeavouring to apply quarantine to other forms of disease. It is noteworthy that, as plague declined in Western Europe, and the area of its prevalence in the Levant became more and more restricted, the system of quarantine appears to have become more elaborate. Speculative notions, uncontrolled by experience, and applied to the system, caused it to be overlaid with grotesque and puerile details. Notwithstanding, however, these drawbacks, the arbitrariness of the system, and the losses it inflicted upon commerce, without obvious proportionate gains, the advantages offered by quarantine in the protection of a country from pestilential disease appeared theoretically to be so great, that neither administrative follies, nor the lessons as to its fallacies derived from experience, nor its general futilities, availed to bring about the substitution of a more rational system of protection.

Quarantine remained substantially unmodified from the termination of the last century to the fifth decade of the present, since which time it has undergone great changes, with a view of rendering the practice more consistent with existing knowledge of the diseases to which it is applied, and of freeing it from the more preposterous detentions and practices which had become attached to it.

Quarantine Acts.—In the present article we shall deal only with quarantine as it exists in this country. In Great Britain and Ireland quarantine, which is carried out under an Act of Parliament passed in the reign of George IV. (6 Geo. IV., cap. 78), has no longer a medical

signification. It is practised, and that only to a limited extent, solely with a view of relieving our maritime commerce from disabilities which would else be imposed upon it by other countries, in which quarantine is regarded as an essential part of the public health administration. The regulation of quarantine is not a function of the department of the Government which is concerned with the sanitary administration of the kingdom (the Local Government Board), but of the Privy Council, aided by the Board of Trade, the subject being dealt with as an international commercial question. In what follows an authoritative official memorandum of the late medical officer of the Local Government Board (Dr. E. C. Seaton) on the subject is closely adhered to.

The Quarantine Act provides for land quarantine and the quarantine of inland waters, as well as for maritime quarantine—internal and external quarantine, so to speak. It does not appear that internal quarantine has ever been enforced in this country since the Act was passed. Maritime quarantine alone has been practised, and this has been applied to three diseases only, all of them infectious diseases of foreign origin, namely, plague, cholera, and yellow fever. Of plague there has been no question in English ports for the last thirty years or thereabouts, except a slight alarm in 1879, consequent upon an outbreak in south-eastern Russia, province of Astrakhan. Against cholera quarantine has not been enforced since 1858, its futility as a precautionary measure in this country having then been abundantly manifested. Yellow fever is the sole disease at present subjected to it in our ports, and this, as already stated, not from the medical necessity, but from the commercial exigency of the case. The only quarantine establishment now remaining in England—that at the Motherbank—is maintained in respect of this disease. Infectious diseases habitually current in this country, such as small-pox, scarlet fever, &c., notwithstanding that the phraseology of the Quarantine Act covers *any* 'infectious disease or distemper,' have always been in practice exempt from quarantine, and dealt with under the general sanitary law of the kingdom. It appears to have been recognised that measures, primarily designed to prevent the introduction into the country of diseases only coming to us from abroad, and which involved international considerations, would be misapplied if used for the purpose of preventing the importation of diseases ordinarily existing here, the limitation of which, and not the exclusion, could alone be in question.

The measures which have been substituted for quarantine against cholera—the only foreign epidemic which at present much concerns the health of this country—consist in a 'system of medical inspection,' the details of which are set forth in an Order of the Local Government Board, dated the 17th July, 1873. This plan differs from 'quarantine' in the following essential respects:—

(*a*) It affects only such ships as have been ascertained to be, or as there is reasonable ground to suspect of being, *infected* with cholera or choleraic diarrhœa; no vessel being deemed infected unless there has been actual occurrence of cholera or of choleraic diarrhœa on board in the course of the voyage.

(*b*) It provides for the detention of the vessel only so long as is necessary for the requirements of a medical inspection; for dealing with the sick (if any) in the manner it prescribes; and for carrying out the processes of disinfection.

(*c*) It subjects the healthy on board to detention only for such length of time as admits of their state of health being determined by medical examination.

The measures for dealing with the sick under this Order are but an adaptation to a particular exigency of the principles of sanitary administration with regard to infectious diseases, which are in force under the general sanitary law of the kingdom.

But though quarantine has no present practical existence in this country, except as regards yellow fever, and all other infectious diseases are dealt with either under the general sanitary law of the country, or such modification of it as has been just described with regard to cholera, the machinery which is maintained under the Quarantine Acts, for obtaining information as to the existence of infectious diseases on board foreign-coming ships, is made available for dealing with all diseases of that kind, whether they are quarantinable or not. The quarantine questions, as they are termed, which it is the duty of the Customs to put to the masters of all such vessels, embrace all infectious diseases; and, in the event of any such disease not of a quarantinable kind being found to exist on board, or to to have existed in the course of the voyage, the quarantine officer is required to detain the vessel and to forward the information with the least practicable delay to the sanitary authority of the port. In regard to cholera, moreover, both the customs and the sanitary authority have certain powers of detaining the vessel specified in the order of the Local Government Board above referred to.

The provisions under Articles 12, 13, and 14 of the Order of the Local Government Board, as to the mode of dealing with persons who may arrive from abroad infected with cholera, will be better understood if a succinct statement be made of the ordinary provisions of the law with regard to infectious diseases in England. The authorities which have to administer that law, as now existing under the Public Health Act, 1875, are the urban, rural, and port sanitary authorities of the districts into which the whole kingdom is divided, and these authorities are empowered:—

(*a*) To provide hospitals or temporary places for the reception of the sick (section 131);

(*b*) Where a hospital or place for such purpose is provided, to remove thither by order of any justice, on a certificate signed by a legally qualified medical practitioner, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, *or on board any ship or vessel* (section 124);

(*c*) To make regulations (to be approved by the Local Government Board) for removing to any hospital, to which the local authority is en-

titled to remove patients, and for keeping in such hospital, so long as may be necessary, any persons brought within their district by any ship or boat, who are infected with a dangerous infectious disorder (section 125);

(*d*) To provide and maintain a carriage or carriages, suitable for the conveyance of persons suffering under any infectious disorder (section 123);

(*e*) To cleanse and disinfect infected premises, and articles therein; to destroy any bedding, clothing, or other articles which have been exposed to infection from dangerous infectious disorder, giving compensation for the same; and to provide all necessary means for the disinfection of infected things (sections 120, 121, 122);

(*f*) To take proceedings against (1) any person who, while suffering from any dangerous infectious disorder, wilfully exposes himself without proper precautions against spreading the said disorder, in any street, public place, shop, inn, or public conveyance, or enters into any public conveyance without previously notifying to the owner, conductor, or driver thereof that he is so suffering; or (2) any person who, being in charge of any person so suffering, so exposes such sufferer; or (3) any person who gives, lends, sells, transmits, or exposes without previous disinfection, any bedding, clothing, rags, or other things which have been exposed to infection from any such disorder; or (4) any owner or driver of a public conveyance, who shall not have immediately provided for the disinfection of such conveyance, after it has to his knowledge conveyed any person suffering from a dangerous infectious disorder; or (5) the owner of any house in which any person has been suffering from any dangerous infectious disorder, who shall knowingly let it or part of it for hire, without having previously disinfected it, and all articles therein liable to retain infection, to the satisfaction of a legally-qualified medical man; or (6) any person who, showing for the purpose of letting for hire any house or part of a house, shall make false statements as to the existence of infectious disease therein, or within six weeks previously (the several acts here enumerated constituting offences liable to penalty under the Public Health Act, secs. 126, 128, 129);

(*g*) To provide mortuaries, and to obtain the removal thither, by order of a justice, of the body of one who has died of any infectious disease, which is retained in a room where persons live or sleep, or of any dead body in such a state as to endanger the health of the inmates of the house or room in which it is retained (secs. 141, 142);

(*h*) To make inspection of their district, with a view to ascertain what nuisances exist calling for abatement under the powers of the Act, and to enforce the provisions of this Act in order to abate the same (sec. 92): a provision which extends to shipping—any ship or vessel lying in any river, harbour, or other water, within the district of a sanitary authority, being subject to the jurisdiction of that authority, in the same manner as if it were a *house* within such district;

(*i*) Finally, to appoint a medical officer of health, inspector of nuisances, or several of those officers, according to the needs of the district, and other requisite officers, to aid them in the proper and efficient execution of the Act (secs. 189, 190). The duties of the medical officer of health and of the inspector of nuisances, when (as is the case in the greater number of instances) the assent of the Local Government Board has to be given to their appointment, are set forth in Orders of the Board dated March 1880.

The general powers above enumerated, if exercised duly and with reasonable diligence, are held sufficient to provide for the exigencies which may arise in our ports from the introduction of infectious diseases by ships, whether the disease be current in this country or be of foreign origin not naturalised here; but in the case of a non-naturalised disease, such as cholera, certain additional securities are taken by the Order of the Local Government Board, 17th July, 1873, previously referred to. The general powers, moreover, which are available against the importation of infectious diseases by shipping, are available also, and have on occasions been used, against their exportation in like way to other places.

The relative advantages of the system of medical inspection and of quarantine as against cholera in the ports of Europe, underwent thorough discussion at the International Sanitary Conference which was held in Vienna in 1874. A large majority of the delegates, including those from every State of the first rank except France, declared in favour of the former system. The minority, while adhering to quarantine, agreed to a system which would considerably diminish its stringency as heretofore practised.

HARRY LEACH.

**QUARTAN** (*quartus*, the fourth).—A form of ague, in which the paroxysm returns after an intermission of two days. *See* INTERMITTENT FEVER.

**QUEENSTOWN, in South of Ireland.**—Mild, not relaxing, winter climate. Southern exposure, with shelter. Mean winter temperature 44·1° Fahr. *See* CLIMATE, Treatment of Disease by.

**QUINISM.**—SYNON.: Cinchonism; Fr. *Quinisme*; Ger. *Cinchonismus*.

DEFINITION.—A group of symptoms, chiefly connected with the nervous system, produced by the presence of quinine in the system.

ANATOMICAL CHARACTERS.—In the rare cases in man in which death has been due to quinism, *post-mortem* examination has revealed only congestion of the brain, liver, and lungs. In addition to these, congestion of the spinal cord, kidneys, stomach, and intestines has been found in experiments on animals.

SYMPTOMS.—Large doses of quinine, or smaller doses long continued, may produce two separate sets of symptoms, each independent of the other, according as they act locally on the intestinal canal, or upon the nervous system after absorption. It is to the nervous symptoms that the term cinchonism is usually restricted.

Before considering these symptoms in detail, however, it may be advisable to mention the local effects of quinine upon the intestinal canal. These are, irritation, either of the stomach or

intestines, which manifests itself sometimes in vomiting, and sometimes in purging. Not unfrequently, also, small doses of quinine will cause headache, independently of either vomiting, purging, or the nervous symptoms which are peculiar to cinchonism. This headache is probably caused reflexly by the irritant action of the quinine on the stomach or intestines, and may not depend on any special action that it exerts upon the nervous system after its absorption.

The nervous symptoms to which the term cinchonism is applied consist of affections of the hearing and sight, cephalalgia, and sometimes giddiness. Delirium, convulsions, and collapse are said to occur after very large doses.

Noises are heard in the ears, the sounds being of a humming character, or resembling a distant waterfall, the ringing of bells, or the striking of a clock. These noises are accompanied by more or less deafness, voices being heard as if the speakers were at a distance. Sometimes the deafness becomes complete. It is usually temporary, but frequently lasts for several days after the quinine has been stopped, and has occasionally proved permanent. Affections of the sight are less common. They consist of occasional optical illusions, intolerance of light, amblyopia, mydriasis, and even blindness after large doses. Headache may sometimes be produced by small doses of quinine, without any affection of the sight or hearing; and, on the other hand, the hearing may be very considerably affected without any headache occurring, although this is frequently present. The pain chiefly affects the top of the head and the temples. Occasionally a curious sensation is observed, as if the top of the head were coming off. This sensation is not accompanied by pain. Giddiness also comes on, so that the patient may have difficulty in standing or walking, either after a single large dose, or after repeated or continued moderate doses. This is preceded by an affection of hearing, sight remaining unaffected. The giddiness is probably partly due to weakness of the circulation, in part to the action of quinine on the nerves and nervous centres. Experiments on animals have shown that quinine diminishes greatly the reflex function of the spinal cord, diminishes also sensibility, and, finally, paralyses the extremities. In some persons large doses of quinine cause a febrile condition unaccompanied by cephalalgia, but preceded by humming in the ears, disturbance of the mental faculties, and a slight rigor. In others, the cerebral symptoms have been so marked as almost to amount to a temporary mania.

The circulation is weakened by large doses of quinine, the heart becoming feebler, and the arterial tension diminishing. Not unfrequently fainting has been observed; and therefore persons fully under the influence of quinine should be careful not to rise up suddenly. In some casse collapse and coma occur, occasionally accompanied by convulsions.

Treatment.—As a chemical antidote in cases of quinine poisoning, tannin or substances containing it should be given; and to combat the symptoms produced by quinine, already described, ammonia should be administered, and counter-irritation should be applied to the skin. Cold compresses to the head, leeches behind the ears, and purgatives may be employed when there is excitement or delirium. Alcohol and diffusible stimulants may be given if there is a tendency to collapse. T. Lauder Brunton.

**QUINSY** (*cynanche*, sore-throat).—A popular synonym for acute inflammation of the tonsils. *See* Tonsils, Diseases of.

**QUINTAN** (*quintus*, the fifth).—A form of ague, in which the paroxysm returns after an intermission of ninety-six hours. *See* Intermittent Fever.

**QUOTIDIAN** (*quotidie*, daily).—A form of ague, in which the paroxysm occurs at the same hour every day. *See* Intermittent Fever.

# R

**RABIES** (*rabies*, rage or madness).—Synon.: Fr. *la Rage*; Ger. *Hundswuth*.

Definition.—A non-febrile disease, due to a specific poison; and most frequently met with in the canine, feline, vulpine, lupine, and other species of carnivora; but communicable by inoculation to all warm-blooded animals. It is accompanied by an inclination to attack other animals; and is characterised by nervous disturbances, together with listlessness, uneasiness, wildness, cramps, paralysis, rapid emaciation, altered voice, quick course, and fatal termination.

Ætiology.—Various antecedent phenomena are supposed to be either the actual or predisposing causes of rabies; but we may say that neither climate, season, food, water, sex, genital excitement, pain, anger, age, nor breed, as far as we are able to judge, has the slightest effect in producing the disease.

Many persons still adhere to the belief that rabies arises spontaneously in the canine, and probably also in the feline, lupine, and vulpine species of carnivora; although most, if not all, admit such cases to be extremely rare (Boerhaave, Hamilton, Gilman, Coleman, Renault, Haubner, Williams, Hill, &c.). Others (Maynell, Blaine, Youatt, Virchow, Gerlach, Röll, Böllinger, the writer and many more) believe that it never arises spontaneously, but that it is always

the result of the introduction of the specific animal poison into the system, either by a bite from a rabid animal, or by the absorption of the virus through the medium of an abraded surface. To prove beyond doubt, in any given case, that affected animals had never been bitten, nor placed in contact with those already diseased, is extremely difficult.

Contagium.—The nature, composition, and the circumstances necessary for the production of this, as well as of most other animal poisons, is still a mystery. All we know is, that it is a *fixed virus*, and therefore, can only be introduced into the system by inoculation. It seems to be more concentrated and abundant in the saliva than in any other part of the body; but we have reason to believe, it is present in the secretions and excretions (Röll, Hering), in the blood, and consequently in all organs and parts of the still warm body (Haubner, Eckel, Lafosse, Röll, Fleming, and others); although others (Breschet, Majendie, Dupuytren), from some cause or other failed to transmit the disease by inoculating with the blood of rabid animals. Whether the poison is present in the saliva, blood, and other parts during the incubative stage is unknown. There is no evidence to show that dried virus is virulent; and the contagium is found to be destroyed by ordinary influences, such as heat, calcium chloride, caustic alkalies, and concentrated acids. It is a disputed point whether the meat and milk of rabid animals are fit for animal food; but few doubt the innocuousness of butter and cheese made from such milk. M. Galtier has recently (1881) found that the saliva of a rabid dog which has succumbed to the disease, or has been killed, does not lose its virulent properties through mere cooling of the body. It is important, therefore, in examining the cavities of the throat and mouth after death, to guard against inoculation. The same observer has also found that the saliva of a rabid dog, obtained from the living animal and kept in water, continues virulent for five, fourteen, or even twenty-four hours in the case of the rabbit. Water from which a mad dog may have drunk must, therefore, be considered dangerous for at least twenty-four hours. Although previous observations and experiments seem to prove that the virus loses its potency as soon as the body is cold, or *rigor mortis* has set in, and it has therefore been assumed, *à fortiori*, that the flesh of rabid animals might be eaten cooked (Dr. Lecamus) or uncooked (Decroix, Bourrel, &c.) with impunity, even if the mucous surfaces were injured, these statements must now be received with great reserve.

Animals that are inoculated with fresh (warm) saliva, blood, &c. do not in all cases contract the disease. Renault inoculated ninety-nine animals (horses, dogs, and sheep), and only sixty-seven became affected. Röll says that successful inoculations vary from 24 to 70 per cent., whilst from the bites of rabid dogs the proportion varies between 20 and 70 per cent., showing that the disease is comparatively less likely to follow from the natural (bite) than from the artificial (injection, &c.) introduction of the virus. This is probably due to the bleeding produced by the bite washing the poison out again, or to the bitten subject, the clothes, hair, &c. wiping the teeth before they pierce the skin. The recent researches of MM. Pasteur and Galtier seem to show that the diluted poison of hydrophobia, injected into the blood of animals, acts as a preventive of the development of the disease. It must also be remembered that the percentage—however the poison is introduced—is larger in carnivorous than in herbivorous animals or man. Fleming tabulates them thus:—'Dogs and cats hold the first place in the scale of susceptibility; then man and the pig; next ruminants, the sheep and goat being more susceptible than the ox; and lastly the horse.'

It has been denied by some authorities (Betti, Girard, Vakl, Huzard, Dupuy, Lafosse, &c.), that the virus of other than canine and feline animals, or those which use their teeth as natural weapons of defence, is capable of transmitting the disease to others. But of late years, this has been proved by many (Bourrell, Eckel, Berndt, Youatt, Breschet, Majendie, Earle, and others) to be incorrect.

Incubation.—The period of incubation in rabies ranges between extremely wide limits; but the average period in any animal may be said to be from three to six weeks. It is comparatively shorter in young than in old animals. Spinola said that gestation prolongs it, and according to Fleming it appears sometimes to be hastened by excitement, anger, sexual irritability, terror, injury to the cicatrix, sudden changes of temperature, and other causes.

Anatomical Characters. — The anatomical changes in rabies are by no means constant, nor do they at all equal what one would expect to find, judging from the symptoms presented during life. The following are the principal lesions found.

The skin may be covered with mud, and wounded, especially about the lips. The visible mucous membranes may be injected; the teeth fractured; the tongue swollen, dark red, and wounded. The mucous membrane of the fauces, larynx, trachea, pharynx, œsophagus, stomach, and intestines may be swollen, congested, hyperæmic, or may present hæmorrhagic erosions, and signs of catarrh. The tonsils and salivary glands may be enlarged and vascular. The stomach usually contains some indigestible and foreign substances, such as pieces of wood, leather, straw, hay, or iron. These, however, are rarely found in herbivorous animals. The small intestines are usually empty, or only contain a mixture of bile and mucus. The solitary, agminate, and mesenteric glands may be found enlarged. The spleen is frequently enlarged and congested, hence the disease has often been mistaken for anthrax. The blood is dark-coloured, and coagulates with a soft loose clot. The kidneys and bladder may be hyperæmic, and the latter is usually emptied and contracted. The lungs are generally gorged with blood. The vessels of the cerebro-spinal coverings may be congested, and serous effusions in the cavities will be sometimes observed. Williams says: 'On the lower surface of the medulla oblongata, at the origin of the seventh, eighth, and ninth pairs of nerves, the membranes are generally highly congested, thickened, softened, and matted together.' The

brain-substance may be soft and friable; there is rarely congestion; and, as a rule, the brain is pale and bloodless (Fleming).

The *microscopical* changes have not at present been thoroughly worked out. Benedikt concludes, from examinations of numerous sections taken from various parts of the nervous centres, that the pathological process in this disease consists in acute exudative inflammation with hyaloid degeneration, which doubtless arises from the exudative infiltration of the connective tissue (Fleming). *See* HYDROPHOBIA.

SYMPTOMS.—In the lower animals, the trains of symptoms are so marked, that they have given rise to the distinction of two different forms of the disease: one in which the nervous system is excited, hence the terms *furious, wild,* or 'excited' rabies; the other, where it seems to be depressed, and to which the names of '*dumb* tranquil,' 'torpid,' or 'paralytic' rabies have been given. Although this distinction is convenient for description, it must not be forgotten that paralysis, in some form or other, usually sets in, sooner or later, in the excited form; whereas in the latter it is rarely, and then only for a short time, preceded by any signs of excitement or inclination for mischief. In other words, the symptoms of rabies may be divided into three stages, namely, the *premonitory, irritative,* and *paralytic.* In the 'furious' form, all three stages are well-marked; but in the 'dumb' form, only the first and last. The transition from one stage to the other is gradual and imperceptible.

The *premonitory stage* is characterised by an alteration in the manner and habits of the animal. Dogs, for instance, that are naturally friendly and docile, suddenly turn surly and bad-tempered, and as quickly return again to their former docile manner, showing more affection than usual. Nearly all animals are restless, and frequently change their posture and position. Most are dull, lazy, languid, and seek seclusion from society by hiding themselves in dark and quiet places. Irritation at the seat of inoculation, demonstrated by rubbing, nibbling, or scratching the cicatrix, is frequently an early symptom. The appetite is lost, and in ruminants rumination is suspended. Sometimes a depraved appetite is present, evidenced in dogs and pigs by their eating all sorts of strange things, such as wood, iron, &c.; and these, as well as sheep, often swallow their own fæces and urine; whilst the latter have been seen to lick blood and even eat their wool. Carnivorous animals and pigs frequently 'gulp,' as if trying to swallow something, or retch, as though to free their throat from some foreign body; and vomiting sometimes occurs. The visible mucous membranes are red, and saliva almost always (except in horses) drivels from the mouth, due in all probability to dysphagia. The sexual organs of all species, except the pig (Haubner), are frequently excited in the early stage of this disease, and ungovernable salacity is present. The bowels are constipated; the urine suppressed.

These symptoms may last from twelve to forty-eight hours, and then gradually pass either into the irritative, marking the 'maniacal' form or into the paralytic stage, characteristic of the 'melancholic' form.

The *irritative stage* is distinguished by a propensity to injure other animals; by great uneasiness; and by paroxysms of fury and excitement, with intervals of quietude and exhaustion.

The increased restlessness, which marks the commencement of this stage, is manifested differently by various animals. They are constantly changing their position and posture. Dogs lie down in one place and quickly shift to another; horses move their ears backwards and forwards, as though they were listening to some distant sound.

During the paroxysms dogs become excited; disturb their beds; tear carpets, mats, or whatever comes in their way; and bite their kennels, chains, other animals, and even their own bodies. They may lie quietly for a time, and then suddenly jump up with a peculiar howl; remain in the same posture for a time; look vacantly around them; then suddenly walk forward as though following something; and all at once snap at some imaginary object. The dog may obey its master's call, although reluctantly, and look up pitifully, as though it did not wish to be disturbed. The tongue is swollen, and frequently dipped into water to cool it, although the poor creature cannot swallow any, and saliva hangs in strings from the angles of its mouth. The countenance is anxious and haggard. If the animal should succeed in escaping from its kennel at the early part of this stage, he wanders forth 'on the march,' apparently not knowing or caring where he goes. If anything comes in his way he immediately attacks it, and then resumes his journey. The gait and carriage of the dog are at first natural, but as the nervous energy fails, he becomes unsteady and tottering; the tail drops between his legs; his head is carried near the ground; the abdomen is 'tucked up;' and the poor beast, which a few days previously was plump and fresh-looking, is now comparatively a skeleton. Dogs generally endeavour to retrace their way back to their homes to die. Cats are very savage, arch their backs, lash their tails, and freely use their teeth and claws. Horses become very violent, frequently neigh, bite the bars and mangers, kick, paw, and endeavour to get loose. Cattle rarely, if ever, use their teeth, but bellow, paw the ground, butt and toss, frequently breaking their horns. Sheep seldom, but goats often, use their teeth. Their natural timidity is replaced by a pugnacious disposition, and they will even attack dogs. Pigs slaver at the mouth, bite their fellows and other animals, and become very wild. Poultry make stupid high jumps and other frenzied movements, peck one another, and chuckle frequently. The voice of all animals affected with rabies is altered in character, and is continually being exercised. In dogs, the character of the voice is one of the best diagnostic signs of the disease. It has a peculiar high-toned, croupy, ringing sound, as if the bark and howl were blended together. In the early part of this stage of the malady, the eyes are bright and glaring—especially in cats; but as the disease advances, the bulbus oculi retracts in its orbit, and the membrana nictitans is forced half over

the cornea, giving the animal a horrible and forlorn appearance.

At first the paroxysms are strong and prolonged, but as the disease progresses they become weak and short, and the periods of depression which intervene between the paroxysms are lengthened, until finally the animal has not power or strength to move his limbs, when the *paralytic* stage may be said to have commenced. We now notice continual twitching and convulsions of the muscles—even tetanus; and death soon takes place.

The *paralytic stage* of the 'dumb' or 'torpid' form of the disease is marked by 'dropping' or paralysis of the inferior maxilla, rendering the animal unable to bite or bark. Although at the commencement of this stage there may be an inclination in the dog to leave its abode and 'march;' still it is less so than in furious rabies, and if he do go, the creature either quickly returns again, or seeks some secluded spot in which to die. The animal endeavours to remain quietly in a dark place, and takes little notice of what is going on around him. The tongue is swollen, livid, and hangs out of the mouth; the saliva is tenacious and abundant. Paralysis of the posterior extremities soon sets in, and death quickly follows. When the tranquil form of rabies attacks other animals than dogs, it usually paralyses the posterior extremities.

Duration and Termination.—Rabies generally takes a rapid course, sometimes killing within forty-eight hours, and rarely lasting more than ten days, although cases of canine madness have been reported to have lasted from fifteen to twenty days. The duration depends to a certain extent upon the constitutional vigour of the animal. The termination is fatal in all animals.

Diagnosis.—Marochetti and others have asserted that rabies can be diagnosed a few days after inoculation, by the presence of a sublingual vesicular eruption, but there is no evidence to warrant us in believing this statement; and Mr. Fleming remarks, 'that it is much to be regretted that those who have seen these *lyssi* did not resort to inoculation with the contents of the vesicles to prove whether they really contained the morbific elements or not.'

The most characteristic symptom of the 'furious' form is undoubtedly the peculiar voice; and of the 'dumb' form the dropping of the inferior maxilla. But since these symptoms only appear when the disease is comparatively advanced, we must take other symptoms into consideration, such as the behaviour of the animal, its physiognomy, inclination to bite, and to eat strange and indigestible substances. An acquaintance with the history of the case is necessary if we would avoid confounding it with other diseases.

*Epilepsy* is distinguished from rabies by the sudden and complete loss of sense, champing of the jaws, foaming at the mouth, convulsions, cries, and rapid recovery.

*Distemper* has sometimes been mistaken for rabies, from the fact that catarrh of the eyes and nose, giddiness, weakness, and emaciation are sometimes present in both diseases; and it is just this, with the fact that epilepsy is sometimes a sequela to distemper, that undoubtedly led the late Mr. Grantley Berkeley, a professed authority on rabies, to state, 'that dogs become utterly insane from distemper, and that if this disease be prevented by vaccination, hydrophobia (rabies) will be decreased.' It is scarcely necessary to say that such assertions are liable to cause great mistakes.

*Foreign substances* in the fauces or pharynx, especially in the dog, may be distinguished from rabies by the history of the case, and by careful examination.

*Inflammation of the throat* only presents one symptom of rabies, namely, inability to swallow.

*Gastritis* and *enteritis* may be distinguished by the absence of the nervous symptoms, and by the pain produced on pressing the abdomen.

*Phrenitis*, especially in horses, may be confounded with rabies; but although the animals may be delirious, there is no inclination to do mischief, nor are they irritated by the presence of a dog or a person, and the course of the disease will soon decide the question.

*Tetanus* in the dog has been confounded with rabies, but this is such a rare disease in dogs, cats, cattle, sheep, goats, and pigs, as to call for no special mention. In horses such a mistake could scarcely happen.

*Anthrax.* The pathological changes of rabies and anthrax, says Mr. Fleming, have at times lent some support to the idea that they were identical, or at least resembled each other. Although vertigo, and a disposition to fury, do in some cases accompany anthrax in the lower animals (especially in the horse), the other symptoms of anthrax, the rapidity with which it runs its course, and the pathological anatomy of the several diseases, will serve to distinguish one from the other. The presence of the bacillus anthracis in the blood is absolutely characteristic.

*Cattle-plague.* The fits of delirium that now and again appear in this disease, as well as the great depression, apathy, and the unsteady gait, have a resemblance to those present in a certain stage of rabies. But this resemblance is very superficial. The existence of the plague in the district, and the appearance of the visible mucous membranes, and the other symptoms during life, as well as the pathological alterations after death, are sufficient to establish a distinction (Fleming).

A ferocious dog has frequently been mistaken for a rabid one.

There are no *post-mortem* signs sufficiently trustworthy or characteristic to enable us to form a correct diagnosis of rabies. The history of the case, however, together with the fact that foreign bodies are present in the stomach, and the mucous membrane of the fauces, larynx, and stomach congested, will materially assist us in forming a correct opinion.

Treatment.—The *curative* treatment of rabies, so far as our experience at present goes, has yet to be discovered; and since the malady is so dangerous to other animals and man, we think its cure ought not to be undertaken, except by experienced persons and under adequate restrictions.

The *prophylactic* treatment, however, deserves our best consideration. If an animal has

been inoculated by a bite from a rabid animal or otherwise, the circulation in the part should be immediately stopped by a compress above it; the wound thoroughly washed, sucked, or cupped; and all parts that are supposed to have been in contact with the virus excised, and either the actual or potential cautery freely applied. In the lower animals, some of the wounds may escape our notice on account of the hair, and therefore even after the above precautions are taken, the subject must be treated as suspicious. Cows, sheep, and pigs, if the wounds have been promptly cauterised, may be used for food, provided they have been killed within twenty-four hours of the inoculation. If an animal is suspected of being inoculated from, or has been in company with, one affected with rabies, it should be kept in a secure place, and watched for at least four months, and then only allowed to go out muzzled, but it is preferable to destroy it. If such an animal has bitten any person, it should not be destroyed until it has been positively ascertained whether it is rabid or not. All affected animals should be killed at once and burned, or buried deep with quick-lime. The researches of MM. Pasteur and Galtier suggest the advantage that may result from the intravenous injection of the diluted poison, for the purpose not only of preventing the disease, but, even after an animal has been bitten, of mitigating the severity of the symptoms.

When a case of rabies has occurred, notice ought to be given at once to the local authorities, to prepare them for making and enforcing stringent measures to prevent its spread. No dogs ought to be allowed to enter public buildings or conveyances, or to frequent the public streets or highways, without a muzzle, under the penalty of being seized by the police.

If a rabid animal is at large, notice should be given of the fact to the neighbourhood as soon as possible. All kennels, chains, collars, and places with which a rabid animal has been in contact should be scalded and disinfected.

GEORGE A. BANHAM.

**RACHITIS** (*ῥάχις*, the spine).—A synonym for rickets. *See* RICKETS.

**RAGATZ, in Switzerland.**—Simple thermal waters. *See* MINERAL WATERS.

**RAILWAY ACCIDENTS, Results of.**—The results of railway accidents are, first, *immediate*, such as those which follow directly and continuously on the occurrence of the accident; and, secondly, *indirect* or *remote*, which follow at a later period, after an interval of apparent immunity. The points of difference between railway injuries and those sustained in other ways, such, for instance, as by a fall from a horse or a carriage, are virtually those of degree. This effect is referable, firstly, to the great weight and impulse of the train, crushing perhaps completely some portion of the body; secondly, in the case of collision, to the sudden arrest of momentum of such ponderous bodies in more or less rapid motion, causing thereby violent vibratory shocks to the travellers. Thirdly, the occurrence being sudden and unexpected, the muscles are, as it were, taken by surprise, and before contraction takes place, the ligaments of the spine are frequently strained or even torn There is no time for preparation; the whole is the work of an instant. Fourthly, in cases of injury to those who jump or fall from a train in motion, the gravity of the resulting injury depends on the rate of speed of the train at the moment; on the part of the body which first strikes the ground, and the angle at which it is struck; on the weight of the person; and also on the nature of the ground.

Accidents which happen to persons either getting into or out of trains not in motion, possess no special characters. It should, however, be mentioned that serious spinal injuries have occurred to persons sitting in a train not in motion, when, by a sudden unexpected jerk, a violent shock is sustained.

It is, therefore, this violent and sudden commotion of the system which constitutes the main feature in this class of injuries, a condition which does not obtain in cases where there is less sudden violence.

Most of the direct results of railway accidents are so obvious as not to need description here. They consist of various kinds of fractures, contusions, and lacerations, caused either by the force of the collision, or by crushing and grinding under the wheels of the carriages when the individual has been run over, or by fragments of splintered wood, iron, and glass, or by burns or scalds. These injuries either cause immediate death; or the patient may ultimately succumb, or he may be permanently injured, or recover. Occasionally death results simply from fright; the influence of intense fear on the minds, especially of persons suffering from heart-disease, aneurism, and the like, being sufficient to cause death. The primary depression produced on the nervous and circulatory system continues and deepens; there is no power to rally; and a fatal result from syncope ensues.

**Direct results on the cerebro-spinal system.**—The injuries following directly upon a railway accident are of considerable interest, both on account of the difficulty of arriving at a definite diagnosis, and because of the important issues dependent on the prognosis. They comprise conditions of general shock and concussion, where the symptoms presented are principally subjective; and of local injury, such as fracture of the skull or of the spine, implicating the brain, the spinal cord, or their membranes, stretching or rupture of spinal ligaments, to a greater or lesser extent, injury to the pelvis, and other lesions.

For a description of concussion of the cord, and the localisation of lesions of the spinal cord, *see* SPINAL CORD, Diseases of.

**Indirect results.**—In this class of cases the extent of the injury is not evident at the time of the accident; for instance, a person in a collision receives a shock of apparently a temporary character; recovers himself sufficiently to be able to assist his fellow-sufferers; returns home; and resumes his usual avocations. After an interval of days, symptoms of spinal trouble show themselves; the person experiences pain in this region, tenderness on pressure or on the application of a hot sponge, and inability to

sleep or to attend to business; he hears noises in the ears; and he feels a general exaltation of the sentient faculties. Cases such as these are frequently the subject of litigation as regards claims for damages against railway companies.

**Medico-legal questions in connexion with railway accidents.**—In cases of claim for compensation for these injuries, it is of the highest importance that the medical men engaged should make themselves thoroughly acquainted with all the circumstances connected with the accident and its results. This applies to the medical attendant of the injured person, as well as to the medical officer examining on behalf of the company.

It will, therefore, be well to refer to the general character of some of the fraudulent claims made upon railway companies.

**Fraudulent claims.**—There are three principal kinds of fraud practised, and sometimes with success, namely, first, by persons who, as may be subsequently proved, were not even present at the time of the accident; secondly, by those who, though present and unhurt, yet simulate symptoms of injury; and, thirdly, by those who, having sustained some trifling injury, wilfully and intentionally exaggerate their symptoms, in order to obtain an unfair amount of compensation. There are, therefore, certain points to which the medical man should attend, lest he should be led away by a well-planned history, and thus unwittingly be made a party to such transactions.

**Duties of the medical attendant.**—1. It is desirable to obtain in writing the patient's statement as regards the accident; if possible ascertaining, approximately, the rate of speed of the train when the accident occurred, the position of the person in the carriage, and whether other persons were present or not.

2. Note bruises or any sign of local injury on any part of the body.

3. Where injury to the spine is alleged, the investigation should be conducted as far as possible according to the following systematic plan:—

(1) Examine the spine by percussion, and by the application of a hot sponge.

(2) Seek for any paralytic phenomena by—

(*a*) Measurement of limbs.

(*b*) Comparative degree of surface sensibility.

(*c*) Comparative amount of electrical irritability of muscles.

(*d*) The existence of spasm or tremor of the muscles of the spine and limbs.

(3) Ophthalmoscopic examination must be made, in order to determine the existence or non-existence of local lesion, confirmatory or otherwise, of cerebral or spinal symptoms.

This done, it becomes the duty of the medical attendant to form an opinion after satisfying himself on the following points:—

α. Has the patient really been injured?

β. What is the nature of the injury?

γ. Is the injury a possible result of the accident as described?

δ. Is the train of symptoms consistent with the appearance of injury.

He should also remember that the simulation of symptoms, such as spinal tenderness or muscular tremor, can frequently be detected by distracting the attention, when pressure on the part previously complained of may be exercised with impunity, and the muscular tremors will cease. This, however, is not conclusive of imposture, for in hysteria, when the attention is diverted, the same occurs. Again, the existence of organic disease previous to the accident should be looked for, as it has happened that symptoms referable to disease—locomotor ataxy, for example—have been erroneously ascribed to injury. The urine should be examined in every case.

As an instance where the truth of a patient's statements may be tested by the astuteness of the medical man, a case may be mentioned where the plaintiff, who had travelled up some fifty miles to London to be examined, stated among other symptoms that his urine continually dribbled from him. The surgeon immediately asked to see his shirt, which had been worn at least six hours, when it was found perfectly dry and devoid of any stain of urine! In another case a man presented extreme spinal tenderness, even to the extent of complaining of pain when the part was blown upon with the breath. A sheet of paper being interposed, without the patient's knowledge, the effect was the same.

**Duties of the medical officer examining on behalf of the railway company.**—The medical officer of the company should not constitute himself the agent of the company for settling the terms of compensation. The examination should be made, if possible, in the presence of the patient's medical attendant, and should be conducted thoroughly, with tact, and without inflicting any unnecessary mental or bodily pain.

A report of the case should be drawn up at the time, giving:—

1. The patient's account of the accident, and of his subsequent and present symptoms.

2. The present condition of the patient, noting particularly any objective signs of injury.

3. An opinion as to whether the symptoms complained of are likely to be the result of the accident, as to the probability of recovery, and at what period.

As the plaintiff in an action has a right to a copy of this report, it should, of course, be worded with extreme care.

The actual question of pecuniary compensation does not concern either the medical attendant of the patient or the medical adviser of the company. They merely have respectively to bring forward facts in support of their opinions as to the value of symptoms, and how far they are dependent upon the injury.

By an early investigation in such a manner as indicated, the practice of fraud would be rendered impossible, and by an accurate knowledge and statement of facts much conflict of medical opinion might be avoided.

**Unintentional exaggeration of symptoms.** There are certain persons who, undoubtedly injured, without having any fraudulent design, may yet unintentionally exaggerate their symptoms in consequence of the continual direction of their minds to their sufferings, whilst an action for damages is pending. The suspense and anxiety the examinations by the medical men,

and the repeated interviews with their solicitors, keep them in a constant state of nervous excitement. When, therefore, their claims are settled, it is natural that the relief they experience should frequently be attended by beneficial results, or even complete recovery. *See* FEIGNED DISEASES.

TREATMENT.—The chief injuries received at the time of a railway accident being surgical, the treatment adapted for each particular case will be found in surgical works. Nevertheless there are some general points in the immediate treatment, to which any medical man present on such occasions would do well to attend.

1. *Hæmorrhage.*—Death from hæmorrhage should be prevented by promptly adopting pressure of some kind. If no tourniquet be at hand, or india-rubber band, a handkerchief tied round the limb and twisted tight with a piece of stick, will suffice for the time, or direct pressure by the finger.

2. *Fractures.*—Temporary splints may be improvised out of cushions, newspapers, straps, and broken pieces of wood, &c., so that the injured may be removed with as little pain as possible, and simple fractures may be prevented becoming compound. Simple dislocations should be reduced at once if possible.

3. *Shock, collapse, and fright.*—In the treatment of these conditions great caution is required to maintain the vital power until reaction sets in. The temperature of the body, the strength and rate of the heart's action, together with the respiration, should be kept up by stimulants and warmth. Mr. Savory, in his article on Shock in Holmes's *System of Surgery*, is careful to point out, however, the dangers of over-stimulation, whereby the flickering powers may be extinguished altogether.

4. *Exposure to wet and cold.*—Every endeavour should of course be made to prevent prolonged exposure, by sheltering the injured as much as possible, and securing their early removal to any neighbouring houses.

W. ROSE.

**RÂLES** (Fr., Rattles).—Certain adventitious sounds heard on auscultation, in connection with the respiratory organs, during the act of breathing, in various morbid conditions. *See* PHYSICAL EXAMINATION; and RHONCHUS.

**RAMOLLISSEMENT** (Fr., Softening).—This word is associated with all forms of softening of tissues and organs; but by English pathologists it is generally used to denote softening of the central nervous system. *See* SOFTENING.

**RANULA** (*ranula*, dim. of *rana*, a frog).—A cystic growth in connection with the mouth, and having several modes of origin. *See* MOUTH, Diseases of.

**RAPE.**—SYNON.: Fr. *Viol*; Ger. *Nothzucht.*

DEFINITION.—By the English law rape is defined as 'the carnal knowledge of a woman forcibly and against her will.'

GENERAL REMARKS.—The crime of rape is punishable by penal servitude for life. The carnal knowledge of any girl under ten years of age is punishable in the same way; and the carnal knowledge of any girl between ten and twelve, under any circumstances, is punishable by three years' penal servitude, since the law rightly considers that children under twelve can have no power to consent to sexual intercourse.

Of cases of rape recorded by Casper, 73 per cent. were upon the persons of little children under twelve. Of 136 cases put upon record by this author, the ages were as follows:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| From | 2½ | to | 12 | years | of age, | 99 | cases. |
| ,, | 12 | ,, | 14 | ,, | ,, | 20 | ,, |
| ,, | 15 | ,, | 18 | ,, | ,, | 8 | ,, |
| ,, | 19 | ,, | 25 | ,, | ,, | 7 | ,, |
| | | | 47 | ,, | ,, | 1 | ,, |
| | | | 68 | ,, | ,, | 1 | ,, |

For proof of the crime of rape it is not necessary that the force employed should have been of a violent physical kind. A mere *threat* of violence, or even of moral injury, is 'force' in the eyes of the law. The surreptitious administration of chloroform, or a narcotic, for the purpose of having intercourse with a woman against her will, is also force in the eyes of the law.

The moral character of the woman is theoretically, but seldom practically, beside the question; and, provided force be used and the woman's consent be wanting, sexual intercourse even with a prostitute is legally 'rape.'

The punishment of the crime of rape was provided for in the criminal code of Moses, who ordained that the ravisher of a betrothed damsel should die.

The Roman law punished the crime with death and confiscation of goods, but provided the following saving clause:—

*Rapta raptoris, aut mortem, aut indotatas nuptias optet.*

Upon this, says Percival, there arose what was thought a doubtful case: '*Una nocte quidam duas rapuit; altera mortem optat, altera nuptias.*'

Many accusations of rape are false and trumped up, and are only brought by the woman when she finds that some sexual indiscretion is likely to bring her into trouble, or cannot be concealed by reason of her pregnancy.

This being the case, *stale accusations* should be received with very great caution. The laws of Henry III. provided that the accusation should be made immediately, '*dum recens fuerit maleficium.*' By the old Scotch law no delay was allowed in bringing the accusation *ultra unam noctem*, and by the modern Scotch law a delay of three days is alone permitted. By the law of England no limit is placed on the time at which an accusation of rape may be made. An English jury is, however, naturally chary of giving credence to a stale charge of rape. Some few years back a charge of rape was brought against a gentleman of position in one of the home counties, by a girl with whom he had had connection some five months previously. There was no evidence that the girl had offered any resistance, and as the accusation was brought only after pregnancy had become evident, and after ineffectual attempts had been made to extort money from the defendant's relatives, and as the charge was evidently made at the instigation of an uncle who was a superintendent of police, and a cousin who was a lawyer, the case was dismissed

It shows, we think, an imperfection in the English law that it should be possible, under such circumstances, to prefer a charge of so serious a crime.

The law for the substantiation of a charge of rape is satisfied with proof of a minimum amount of 'carnal knowledge.' The mere touching of the vulva by the penis is carnal knowledge in the eyes of the law. The complete introduction of the penis into the vagina need not be proved, and still more is proof of emission unnecessary.

The Signs of Rape.—From what has gone before, it is evident that there need be no signs whatever. If a girl be overawed by a threat and her vulva be touched by the penis, that is rape; and, if proved, is punishable as such.

On the other hand, the signs of rape may be very obvious, for example:—

(*a*) The woman may have been heard to cry for help.

(*b*) There may be the signs of a struggle at the spot where the rape was alleged to have occurred.

(*c*) There may be damage to the woman's clothing, and bruises of various parts of her body—signs that she has been subjected to physical force.

(*d*) The genital organs may be found injured; the vulva bruised and perhaps bleeding; the hymen recently ruptured; and, in cases where the disparity in size between the man and woman is very great, rupture of the perinæum and mortal injuries to the vagina.

(*e*) Seminal spots may be found upon the woman's clothing, which is a certain proof of a previous 'intimate relation' with a male. Blood-spots also afford valuable evidence, but necessarily not so conclusive. Care must be taken not to confound menstrual fluid with blood.

The concurrence of all these signs would amount to certain evidence of forcible connection. It must be borne in mind, however, that violence may be done to the female organs in other ways than by forcible connection, and the medical examiner should be upon his guard against inferring too much from the evidence afforded. He also should be on the look-out for facts which may rebut assertions made by the woman. Thus, signs of a previous pregnancy or the evidence of previous venereal disease (scars in the groin, sores upon the pudenda, or symptoms of constitutional syphilis) may serve to disprove any assertions which might be made as to the woman's virginity or previous chastity. To *prove* whether or no a woman be '*virgo intacta*' is next to impossible, and we can only state the probabilities for and against. Such a question, however, is quite beside the mark in many cases of rape; but the presence of an unruptured hymen is an unlikely occurrence after forcible connection. An examination of the person of the supposed ravisher may afford some corroborative evidence. Blood or recent seminal spots upon the linen or clothing, and injury to the person or clothing, all afford their quota of evidence of a sexual act combined with violence.

It is a matter of doubt whether the rape of a woman of fair size and strength be possible by an unaided man. If a woman be in the enjoyment of her faculties she is capable of offering an amount of resistance which would be well-nigh insuperable; and if she have offered a decent resistance, the person of the ravisher should bear evidence of it.

Rape, as we have seen, is most often committed on children of tender years. It is well to be on one's guard against error with regard to the rape of little children. It must have come within the experience of most members of the profession, and especially of those engaged in hospital practice, to have brought to them children suffering from a purulent discharge from the vagina, the mother at the same time alleging that someone must have violated the child. It must be borne in mind that purulent discharges from the vagina are not uncommon in ill-fed, dirty, scrofulous children; and that after some of the infantile acute specifics, sloughing of the pudenda is a rare, though recognised, occurrence. The case of Jane Hampson, æt. 4, who died of sloughing of the genitals at Manchester in 1791, should stand as an incentive to caution in these matters. The signs were considered as those of defloration, and the coroner's jury returned a verdict of *murder* against the boy who slept with her, but luckily for the male child there occurred many other cases of sloughing of the pudenda in Manchester before he was brought to trial, and as the doctor who was called to Hampson recognised and acknowledged his error, the boy was discharged. It was at one time a popular belief that connection with a virgin was a sure cure for venereal disease, and this has led, no doubt, to many cases of rape on young children. The presence of venereal disease in one or both of the parties may be of value as evidence. Its presence in the woman and not in the man affords a strong presumption against rape.

The finding of spermatozoa within the vagina is proof positive of connection. But here, again, care must be taken not to mistake for spermatozoa the *trichomonas vaginalis*—a microscopic organism, not unlike a tadpole in shape, which has been described by M. Donné, as occasionally found in vaginal mucus. It must be remembered, also, that seminal fluid may contain no spermatozoa. Rape is occasionally effected with so much violence that death results. Ogston records the case of one Margaret Paterson, who was raped between Edinburgh and Dalkeith by two carters, who took her into their cart on the pretence of helping her on her journey. They forcibly held her down and repeatedly violated her person, and afterwards took stones from the road, coals, straw, prickly plants, &c., and forced them into the vagina. They then left her in a ditch, and she died in three days of her injuries. *Post mortem* the vagina and rectum were found lacerated and broken down into one passage, and the abdominal viscera in a high state of inflammation. The two carters were convicted and executed.

It has been doubted whether pregnancy can follow rape, but there seem to be no sufficient grounds for this doubt.

When called to a case of supposed rape the medical examiner must remember to take note

of every circumstance—the time that has elapsed since the alleged outrage, the mental state of the woman, her size and physical power as compared with that of the man, evidences of a struggle in the surroundings of the woman, or on her clothing and person. He should keep his mind open to receive any facts which may throw light on the moral character of the woman. He should accurately take note of the exact condition of the genital organs and linen; should take possession of all stained linen for the purpose of chemical and microscopic examination; and should remove a portion of any discharge which may be found in the vagina for the same purpose. In drawing up a report, he should describe, as accurately and drily as possible, all facts which he may notice; and should be carefully upon his guard against drawing any undue conclusions from those facts. G. V. Poore.

**RASH.**—An outbreak of redness of the skin, or efflorescence; called by the Greeks an *exanthema*, or blossoming out. The word rash, or as it were 'rush,' conveys the idea of suddenness, whilst in reference to development it is generally extensive. The best illustrations of the rashes and of the meaning of the term are erythema, the red rash; roseola, the rose-rash; rubeola, the crimson rash, generally known as measles; scarlatina, the scarlet rash; purpura, the purple rash; and urticaria, the nettle rash.

**RATIONAL** (*ratio*, reason). In conformity to reason.—A term applied to the mental state; also to treatment when founded on scientific principles, in contradistinction to *empirical* treatment, founded solely on experience. *See* Consciousness, Disorders of; and Disease, Treatment of.

**REACTION.**—When any substance or influence affects the organism sufficiently to cause appreciable physiological disturbance within it, it is said to have a *physiological action* upon the body; or, more briefly, to *act* or to have an *action* upon it. If the effect of such an influence have been well-marked, the organism does not simply return to the original or ordinary condition, or to what is called the 'physiological balance,' with the cessation of the influence; but passes beyond it into a state characterised by phenomena, which are, speaking broadly, the opposite of the former. The condition which is thus the effect or outcome of the *action* is called the *reaction*; and the same name is also given to the *process* by which the primary effect passes into the secondary. The cold bath furnishes a familiar illustration of physiological action and reaction. The contraction of the superficial vessels, the pallor, the sensation of intense cold, and the fall of temperature, which are the immediate effects of the cold bath, are speedily replaced by such exactly opposite phenomena as dilatation of the cutaneous vessels, flushing of the skin, a warm glow, and a rise of temperature; and in the same way the primary nervous stimulation gives way to a feeling of general calmness and comfort. It is generally found that the phenomena of action and reaction are in direct proportion to each other, unless the action be excessive, in which case reaction may not set in. In other instances the irritability or excitability of the organism, whether as a whole or in part, may be either unnaturally increased or unnaturally diminished, and the reaction be *excessive* or *imperfect* accordingly.

Excessive emotional excitement, whether pleasurable or painful in nature, such as joy or fear, may similarly be followed by corresponding depression, by prostration, or even by death. In the reaction which follows severe injuries, especially when they are met with under circumstances of intense fear—for example, in railway accidents, both the bodily and the mental functions, so called, are simultaneously involved.

The effects of reaction are also illustrated *locally* in the condition of wounds. Local reaction takes the form chiefly of inflammation, and is carefully studied by the surgeon, who finds in it a ready means of estimating the severity of an injury; the vigour of the system generally, and of the affected part; or, it may be, the value of some particular kind of treatment.

Reaction may itself call for treatment when it is either imperfect or excessive. Stimulation is demanded in the former case, for instance, by warmth, alcohol, or ammonia. When reaction is excessive, nervous and circulatory sedatives are equally indicated.

J. Mitchell Bruce.

**RECEPTACULUM CHYLI, Diseases of.** The receptaculum chyli is the dilated portion forming the commencement of the thoracic duct, which receives the contents of the lacteal vessels and of the lymphatics of the lower limbs and abdomen. It lies deep in the abdominal cavity, about the level of the first lumbar vertebra. The only morbid conditions which need be specially noticed in connection with it are *dilatation* and *rupture*. The receptaculum has been found in rare instances enormously dilated, and its walls thickened. It has also been known to burst as a result of this dilatation, with the escape of its contents into the peritoneal cavity, fatal peritonitis being thus set up. It would be quite impossible to diagnose these conditions during life, and they have only been discovered on *post-mortem* examination.

Frederick T. Roberts.

**RECRUDESCENCE** (*re-*, again, and *crudesco*, I become fresh).—The increase or exacerbation of a disease or morbid process, after a temporary diminution; for example, of fever or inflammation.

**RECTUM, Diseases of.**—Synon.: Fr. *Maladies du Rectum*; Ger. *Krankheiten des Mastdarms*.

The diseases of the rectum may be conveniently discussed in the following order:—1. Congenital imperfections; 2. Fistula in Ano; 3. Malignant Disease; 4. Polypus; 5. Prolapsus; 6. Stricture; 7. Villous Tumour; and 8. Ulceration. Other diseases connected with the rectum will be found discussed under special headings. *See* Anus, Diseases of; Defæcation, Disorders of; Hæmorrhoids; and Stools, Characters of.

**1. Congenital Imperfections.**—Malformations of the rectum may be classed as follows:—1. Imperforate anus, without deficiency of the rectum. 2. Imperforate anus, the rectum being

partially or wholly deficient. 3. Anus opening into a *cul-de-sac*, the rectum being partially or wholly deficient. 4. Imperforate anus in the male, the rectum being partially or wholly deficient, the bowel communicating with the urethra or neck of the bladder. 5. Imperforate anus in the female, the rectum being partially deficient and communicating with the vagina. 6. Imperforate anus, the rectum being partially deficient, and opening externally in an abnormal situation by a narrow outlet. 7. Narrowing of the anus. These imperfections can be remedied only partially or completely by surgical operations.

2. **Fistula in Ano.**—DESCRIPTION.—The loose areolar tissue around the lower part of the rectum is occasionally the seat of abscess, which bursts externally near the anus (*see* PERIPROCTITIS). But instead of the part healing afterwards, like abscesses in other situations, the walls contract and become fistulous, and the patient is annoyed by a discharge from the opening. On introducing a probe it may pass through a small opening in the coats of the rectum into the bowel. The case is then called a *complete fistula*. When there is no external opening, the complaint is named *blind internal fistula*. The external orifice is usually near the anus, being indicated by a button-like growth with a central opening. The abscess before bursting may have burrowed to some distance, and the external orifice may be situated in the direction of the buttock or perineum. Fistula in ano arises also in other ways. It commonly originates in a phlegmonous abscess, the action of the sphincter muscle and the disturbance of defæcation preventing the closure of the sac. An ulcer just within the external sphincter sometimes perforates the bowel, allowing the escape of fæculent matter into the areolar tissue, and thus leads to abscess. Ulceration induced by a pointed foreign body, as a fish-bone, may also induce a rectal abscess. In all these cases the inner orifice of the fistula is just within the external sphincter. Fistula occurs also in phthisical subjects, owing to tubercular ulceration of the mucous membrane of the rectum. The inner opening is sometimes found higher up the bowel, and there may be more than one, the sinuses being complicated. An anal fistula is an annoying complaint. The patient is troubled with a discharge which stains the linen, and with the escape of flatus. Fistula is a disease of middle life, more common in men than in women.

TREATMENT.—The cure is by a surgical operation.

3. **Malignant Disease.**—The coats of the rectum are subject to *carcinomatous* and *sarcomatous* disease. These growths invade the bowel to a greater or less extent, contracting the passage irregularly, and sometimes almost closing it. Fungoid growths also spring from the coats and project into the bowel, blocking the passage. The degeneration and invasion of tissues may reach the vagina in the female, or the urethra and bladder in the male, and may even penetrate the peritoneum. Malignant disease may attack any part of the bowel, but generally appears in the lower part, within three inches of the anus. It is liable also to affect, though less frequently, the point where the sigmoid flexure terminates.

DESCRIPTION.—The disease generally commences insidiously. Its early symptoms are often similar to those of simple stricture, and the real disease is not detected until a considerable change has taken place in the condition of the bowel. The patient is troubled with flatulency; has difficulty in passing his motions; and as the disease progresses, experiences pains about the sacrum, which gradually increase in severity, and dart down the limbs. The stools become relaxed and frequent; contain blood; and in passing cause a scalding pain. Often also there is a thin offensive serous discharge. Loss of retentive power may ensue, from destruction of the sphincter, or of the nerve supplying the muscle. As the disease advances the patient loses flesh, and exhibits the blanched, sallow look, anxious countenance, and emaciated appearance commonly observed in persons suffering from malignant disease. In consequence of communications established with the neighbouring passages, liquid fæces escape from the urethra in the male and vagina in the female; and at length the patient becomes hectic and exhausted, worn out by this painful and distressing malady. Complete obstruction may occur, and accelerate the fatal termination. There is great variety in the degree of suffering, and of constitutional derangement. The sufferings are in some instances excruciating, in others very slight. Malignant disease usually occurs in middle life, but occasionally in the aged. It is more common in men than in women.

TREATMENT.—Little can be effected by remedies in this terrible disease, beyond palliation of the symptoms, and ease from pain. The general health may be supported by tonics. The motions must be kept soft by medicines or by injections, and pain must be alleviated by chloral or morphia in suppositories or subcutaneous injections. In cases of obstruction, as well as in cases of severe suffering, life may be prolonged by colotomy. Excision of the diseased bowel has also been resorted to, but not with much success.

4. **Polypus.**—Polypus of the rectum occurs in two forms, the *soft* or *follicular*, and the *hard* or *fibrous*.

DESCRIPTION.—The *soft* polypus consists of an agglomeration of elongated follicles, covered with a distinct cylindrical epithelium, with a network of small vessels ramifying in it, and a peduncle which varies in length. The polypus is usually single, but several may exist. In children the polypus usually makes its appearance at the anus after a stool, resembling a small strawberry, being soft in texture, granular on the surface, and of a red colour. It has a narrow pedicle about the size of a crowquill, two or three inches in length, attached to the wall of the rectum. It produces no suffering, but causes a slight bloody discharge. The *hard* or fibrous polypus occurs in adults, is of a pear-shape, and has a peduncle more or less long and thick. It seldom bleeds, but occasions a slight mucous discharge; and when the peduncle is long, the growth protrudes at the anus after stool.

TREATMENT.—The treatment is very simple. For the *soft* polypus a ligature should be tied round the pedicle. This gives no pain, and the

polypus comes away in two or three days. It should not be excised without the previous application of a ligature, as dangerous bleeding is liable to follow. The *hard* polypus may be removed by ligature or the écraseur.

5. **Prolapsus.** — In relaxed states of the sphincter muscle and coats of the bowel, loose folds of mucous membrane are liable to protrude and require replacement. This protrusion and exposure of thickened mucous membrane, with or without internal hæmorrhoids, has been erroneously described by writers as prolapsus of the rectum. In the true prolapsus, there is much more than an eversion of the lining membrane of the bowel. The gut is inverted; there is a 'falling-down' and protrusion of the whole of the coats—a change analogous to intussusception, but differing from it in the circumstance that the involved intestine, instead of being sheathed or invaginated, is uncovered and projects externally.

Ætiology.—Prolapsus is observed generally between the ages of two and four, but may occur later in life. In infancy it is produced by protracted diarrhœa. The straining efforts to pass water in stone in the bladder also give rise to this affection in young subjects. In adults the descent results chiefly from a weakened condition of the sphincter and levator ani muscles. It is more common in women than in men, arising in the former from the parts being weakened in child-bearing. Young subjects generally outgrow this complaint by the period of puberty; and common as is prolapsus in early life, it is rather rare in young grown-up subjects.

Description.—The length of bowel protruded varies from an inch to six inches or even more. When not of any great length, the protrusion forms a rounded swelling which overlaps the anus, at which part it is contracted into a neck. In its centre there is a circular opening communicating with the intestinal canal. An inversion of greater length forms an elongated pyriform tumour, the free extremity of which is tilted forwards or to one side. The protrusion may present the usual florid appearance of the mucous membrane; or a violet, livid colour from congestion, consequent upon contraction of the sphincter. The mucous surface is often thickened and glandular, and sometimes ulcerated from friction against the thighs and clothes. Thickening of the coats of the bowel accounts for the difficulty in reducing the parts, and keeping them reduced afterwards, so often experienced in the treatment of these cases in children, the bowel being too large to be conveniently lodged in its natural position, and like a foreign body exciting the action of expulsion. An atonic or relaxed state of the sphincter muscle is shown by the facility with which one or two fingers can be passed through the anus even in young children.

Treatment.—In children irritability of the bowels and diarrhœa must be checked, and disordered secretions corrected, by suitable remedies. In slight cases it will be sufficient to direct the nurse by steady compression to push the protrusion back into the pelvis. The relaxed state of the membrane may be treated with astringent injections of alum, or muriated tincture of iron, used cold. If the bowel slips down when the child moves about, a rectal supporter may be worn. When the exposed surface is ulcerated, it may be painted with a solution of nitrate of silver, 20 grains to the ounce. The patient should be made to relieve the bowels in the recumbent posture. In adults the anal aperture may be contracted, and the fall of the rectum prevented, by the application of the mineral acids or of potassa fusa to the mucous membrane near its junction with the skin. In more severe cases the complaint may be remedied by operation.

6. **Stricture.**—Stricture may be very limited in extent, and is then termed *annular*; or the contraction may include a portion, more or less considerable, of the coats of the bowel. Above the stricture the rectum is commonly dilated and thickened, owing to a general hypertrophy of the bowel, particularly of the muscular coat. The mucous coat at this part is usually red from capillary injection, and ulcerated, and supplies an abundant purulent discharge. Often ulcerated apertures lead to fistulous passages, extending some distance, and opening externally near the anus or in the buttock, and in women in the vagina. The stricture is usually at the lower part of the bowel, from an inch and a half to two inches from the anus. It also occurs at the point where the sigmoid flexure terminates in the rectum. The disease originates in chronic inflammation of the mucous and submucous areolar tissue of the rectum. Women, in whom the disease is much more common than in men, have ascribed its origin to a difficult labour, during which the bowel was injured. Strictures of the rectum often also originate in the contraction consequent upon the healing of ulcers or wounds in the bowel, especially syphilitic. It is a disease of middle life.

Description.—The earliest symptom is habitual constipation, with difficult defæcation when the motions are solid. As the contraction increases, the constipation becomes more obstinate, and the stools are diminished in calibre, and are often voided in lumps. A brown slimy fluid escapes with the motions, and there is a burning sensation after stool, and flatulent distension of the colon. As the disease makes progress and ulceration ensues, the discharges become purulent and bloody, and the sufferings are much increased. There is sometimes so copious a discharge as to mislead the practitioner, the stricture being overlooked, and the case treated as one of protracted diarrhœa. The appetite may remain good, and the general health may be but little impaired; but in the course of time the derangement of the digestive functions, the irritation kept up by the disease, and the exhausting discharges bring on hectic symptoms. The appetite fails, the body emaciates, night-sweats become profuse, and the stricture directly or indirectly becomes the cause of death. This is sometimes hastened by a lodgment of hardened fæces or some foreign body just above the stricture, so as to block up the passage, and occasion all the symptoms of internal obstruction. In patients with stricture small flattened excrescences are usually observed at the margin of the anus. These cutaneous growths resemble collapsed external piles, except that they are redder

in colour, and are kept moist by the escape of an irritating discharge from the bowel. In many cases the interior of the rectum is abundantly studded with small excrescences or irregular growths of the surface, and folds of the mucous membrane, the result of chronic inflammation.

Diagnosis.—A stricture in the lower part of the rectum can be easily detected by tactile examination. It must be borne in mind that the bowel is liable to be obstructed by disease of the neighbouring viscera, an enlarged or displaced uterus, fibrous tumours of this organ, an ovarian growth, pelvic hæmatocele, excessively hypertrophied prostate, or hydatid tumour between the bladder and rectum.

Treatment.—The main object in treatment is to dilate the contracted parts sufficiently for the free passage of the motions, and this is to be effected by mechanical means—by the passage of bougies. Means must also be adopted to relieve the irritability of the part, and to ensure the regular passage of soft evacuations. Opiate suppositories at bed-time, castor oil, cod-liver oil, aperient waters, and local applications of solution of nitrate of silver, are the remedies required. In old inveterate strictures, wearing out the patient's strength, the writer has recommended colotomy.

7. **Villous Tumour.**—Villous tumour, a growth similar to that which occurs in the bladder, springs from the mucous membrane of the rectum, generally by a broad base; is soft in structure; and is composed of a number of projecting papillæ or villi. It is innocent in character, and is not apt to return after removal. Its chief peculiarity is a remarkable disposition to bleed. The villous tumour occurs only in adults, and is a rare disease. It should be removed by ligature if possible, or by the clamp-forceps.

8. **Ulceration.**—Description.—Chronic ulceration may arise from *dysentery*, *tubercular disease*, or *syphilis*. *Dysenteric* ulcers are extensive, and occur to persons who have been in tropical climates, or exposed to hardships, and deprived of proper nutriment. The *tubercular* ulcer is usually small in size, but indisposed to heal. *Syphilitic* ulcers are large, deep, and irregular, and occur generally in women It is a question whether they are due to direct contagion, the mucous membrane of the bowel becoming inoculated with matter from sores on the vulva, or in a more direct way, or whether the ulceration is the result of constitutional disease. The chief symptoms are a purulent discharge from the anus; motions loose and mixed, or coated with a slimy fluid and streaked with blood; soreness in defæcation; and occasionally tenesmus. The characters, position, and extent of ulceration can be ascertained by examination with the finger and with the speculum.

Treatment.—The treatment depends on the nature and extent of the disease, and upon the constitutional condition of the patient. In severe cases the patient should be kept in the recumbent position. In extensive destruction of the mucous surface, with free discharges, especially when originating in dysentery, vegetable astringents, such as simaruba and krameria, combined with mineral acids and opiates, are of great service in restraining the tenesmus and irritating discharges. The nitrate of bismuth, with magnesia and anodynes, also affords great relief, and the sulphate of copper with opium may often be given with advantage. When the ulceration is consequent on constitutional syphilis or scrofula, the remedies appropriate to these diseases are required. The local treatment consists in the application of weak solutions of nitrate of silver or sulphate of copper, and anodyne injections with mucilage, or anodyne suppositories.

T. B. Curling.

**RECURRENT DISEASES.** — Diseases which have a tendency to return after their actual or apparent cure or removal, either without any obvious cause, such as cancer or ague, or from some very slight cause, such as gout or rheumatism.

**RECURRENT INSANITY.** *See* Insanity, Varieties of.

**RECURRENT LARYNGEAL NERVE, Diseases of.**—*See* Pneumogastric Nerve, Diseases of.

**RED GUM.**—An eruption of scattered red pimples on the skin of infants; more scientifically described as *lichen urticatus*. In infants the eruption has obtained the name of *strophulus*, from its presumed association with a disordered state of the bowels, accompanied with colic. The term 'gum' alludes to a resemblance between a pimple on the skin and the exudation of gum from a tree in the form of a drop, and is an illustration of the frequent reference to the vegetable kingdom in the nomenclature of skin-diseases. *See* Lichen; and Strophulus.

Erasmus Wilson.

**REDUPLICATION.**—A doubling; a term generally used in reference to the sounds of the heart. *See* Physical Examination.

**REDUX** (Lat., returned).—A term signifying the return of certain physical signs, after their temporary disappearance in the course of a disease; usually associated with crepitation in pneumonia, and with friction in pleurisy and pericarditis. Redux signs are usually significant of a favourable tendency in a disease. *See* Physical Examination.

**REFLEX DISORDERS.** — These constitute a very varied group of affections, most of which are individually considered elsewhere, in separate articles. But it will be useful here to say a few words concerning them as a group, in order that the mutual relations of many apparently discordant conditions may thus be set forth, from the point of view of their origin or pathogenesis.

Pathology.—The factors concerned in the production of a reflex disorder are in kind those which are needful for the production of a 'reflex action'—though in the former case such causes act for an inordinately long time, or else with an intensity which is altogether unusual. In each case we must have (*a*) afferent impressions resulting from the influence of a foreign body or a pathological state (such as inflammation or ulceration), acting as an irritant upon *afferent*

*nerves*, either in some part of their course, or in their peripheric sites of distribution—whether such sites be situated upon the external surface of the body, or upon some part of one or other of the mucous surfaces within the body. Thus it happens that the determining cause may in some cases be associated with painful impressions, though in many other instances such impressions may be more or less completely absent. Occasionally mental emotions may take the place of peripheric impressions, as inciters of abnormal reflex phenomena.

The next essential factor (*b*) is that the afferent impressions (painful or non-painful) produced by the irritant or pathological state, should pass from the nerves, conveying them through a related *nerve-centre*, which, from one or other cause, chances to be in a state of exalted activity; and thence (*c*) be reflected along one or other set of *efferent nerves*, so as to produce effects of this or that order.

Varieties.—As efferent nerves are distributed to glands, and to muscles (both involuntary and voluntary), reflex phenomena may show themselves in one or other of two principal directions—that is, (1) by the modification of the quantity or quality of some *secretion*, or (2) by the production of spasmodic contractions in certain *muscles*, either of the involuntary or of the voluntary type. In these ways, multitudinous and varied effects are apt to be produced on different occasions, as may be gathered from the following brief illustrations.

1. *Modified secretions.*—The morbid effects belonging to this class of reflex disorders show themselves, for the most part, by a diminution rather than by an increase in the amount of the secretion of the gland whose functions are affected, as when irritation of some of the abdominal nerves leads to a suppression of the renal secretion, by setting up some form or mode of inhibitory influence. The action of cold upon the external surface of the body in producing an increased secretion of urine, is probably brought about by an augmented determination of blood to the kidneys, and not as a simple result of reflex action. The mental conditions of anxiety, fear, or terror do, however, often lead to an increased secretion of urine; and the increased secretion in these cases may be brought about by simpler and more purely reflex influences. Again, precisely the same mental states may lead to an arrest of the salivary secretion, as well as to such an increase of the intestinal secretions as to produce loose evacuations or actual diarrhœa. Other instances might be included under this head, but they are all of them phenomena whose precise mechanism is comparatively obscure. Still in each case the mode of production of the phenomena would seem to conform to the type indicated.

2. *Muscular spasms.*—The morbid effects belonging to this second class of reflex disorders are also variable in their occurrence, and more or less uncertain as regards their precise mechanism. Still, reflex spasms, set up by some contiguous source of irritation, are met with not unfrequently in the urethra and neck of the bladder, in the sphincter of the vagina, or at the commencement of the œsophagus. They may also occur in the bronchi, or in portions of the intestinal canal; likewise in the ureters or in the gall-ducts, during the passage of calculi along either of them.

As an instance of a spasm engendered in involuntary muscular fibres, under the influence of a mental emotion or state, rather than a peripheric irritation, one may cite the sudden contraction of the uterus in certain cases of abortion induced by fright, anger, or other powerful mental emotion. Again, acts of vomiting are produced occasionally by certain sights or odours.

In the voluntary muscles tonic spasms of a reflex character occur, especially in children or in females of a nervous temperament, in the form of contractions of some of the muscles of the extremities more especially, though at other times the muscles of the jaw or some of the muscles of the neck may be the parts involved. *See* Spasm.

Of infinitely more importance, however, are the multitudinous cases in which some sources of irritation, either within or on the surface of the body, occasion, in various more or less obscure ways, through the intervention of the great encephalic centres, convulsions or fits of one or other variety (*see* Convulsions; and Epilepsy). Here we have, as a result of the peripheric irritation, a whole series of spasms, partly tonic and partly clonic in character. It is worthy of note, too, that an irritant at the surface of the brain, in certain regions, is just as potential as an irritant acting upon the mucous membrane of the intestine.

But another class of reflex muscular spasms still remains, to which an immense amount of importance is attached by some pathologists, namely, those which are brought about through the agency of vaso-motor nerves acting upon the contractile walls of blood-vessels. It is well known that under the influence of direct irritation, vaso-motor nerves may cause small arteries and arterioles to contract to an extreme degree, and that this condition is apt to be followed by one of extreme dilatation of these same vessels. It is known also that under the influence of emotions the calibre of the vessels in certain parts of the body is apt to vary greatly. Of this we have examples in the temporary pallor of the countenance produced by fright, and in the suffusion of the face and neck, from unnatural fulness of vessels of these parts, in the act of blushing. On the other hand it is assumed that, as a result of some abiding irritation in the intestine, in the bladder, or in other parts, reflex contractions of the arterioles in certain regions of the spinal cord (also of an abiding character) may be brought about, so as more or less completely to annul the functions of this particular portion of the cord, and thereby to lead to paralysis of the lower extremities—that is, to paralysis of the limbs chiefly in relation with the region of the cord affected. This is the generally assumed mode of production of a so-called 'reflex paralysis.' Others, however, imagine that, in certain cases at least, such a paralysis may be brought about differently—not by the reflex action producing a spasm of vessels in a part of the spinal cord, but by a spasm of the vessels supplying the great nerves and muscles of the

limbs affected. The anæmia, thus supposed to be induced in either case, is regarded as the cause of an ensuing paralytic condition. But the question as to the probability of the existence of 'reflex paralysis' need not be here discussed, since the arguments for or against the existence of such a paralysis which are applicable to one form of it are applicable also to another, and these are set forth in the article SPINAL CORD, Special Affections of—*Reflex Paraplegia.*

It is right here, however, to add that the late Dr. Meryon put forth an entirely different account of the origin of 'reflex paralysis.' He assumed that the irritating body or process (that is, an influence slight in degree, but long-continued) gave rise to a determination of blood in related portions of the spinal cord; that the continuance of this condition led to an overgrowth of connective tissue; that this overgrowth caused pressure upon the imbedded nerve-fibres; and thus induced paralysis in related portions of the body. This view is throughout based upon positions of which no proof exists; and if such a mode of production of paralysis, in response to local irritation, did really obtain, it would, by hypothesis, be by the establishment of a permanent lesion, as a result of which we certainly should have no right to expect a fluctuation in the degree of the paralysis, in accordance with fluctuations in the amount or intensity of the local irritation, or a comparatively sudden cessation of the paralysis so occasioned, sequential to a cessation of the local irritation. Yet these are the assumed differential characteristics of a paralysis of reflex origin.

It does not seem to be imagined by anyone that a local irritation is capable of engendering a condition of paralysis by any direct inhibitory process. The intervention of altered conditions of vaso-motor nerves and of altered states of vessels seems to be postulated by all. Yet some such direct influence may, perhaps, be more possible in those related cases in which the starting-point or primary cause of paralysis is a mental state rather than a peripheric irritation—that is, in the ætiologically obscure cases described by Reynolds as *paralysis dependent upon idea.* *See* SPINAL CORD, Special Affections of, No. 9.

It is right here, also, to mention a class of phenomena which have some analogies to reflex disorders, that is, the numerous cases in which, as a consequence of irritation in one or other region, *pain* is felt in some more or less distant part of the body, as when a stone pressing upon the neck of the bladder causes severe pain at the meatus urinarius, or when disease of the stomach or of the liver causes a pain which is felt in the scapular region. H. CHARLTON BASTIAN.

**REFLEXES, Spinal.**—*See* SPINAL CORD, Diseases of; p. 1458.

**REFRACTION, Disorders of.** *See* VISION, Disorders of.

**REFRIGERANTS** (*refrigero*, I cool).—DEFINITION.—Remedial agents which lower the body-heat, either in health or in disease; or which allay thirst, and impart a feeling of coolness.

ENUMERATION.—The chief refrigerants are:—the whole class of Febrifuges; Water; Ice; Effervescing drinks; Acids; and the juices of Fruits.

ACTION.—As the name implies, anything may be ranked as a refrigerant which lowers the body temperature, and we may here consider in how far the drugs described under FEBRIFUGES have the property of cooling down the healthy organism. Quinine and alcohol have but a slight and transient lowering effect, and salicylic acid has none at all; and this is readily explained, if we believe that their antipyretic properties in fever depend on their destructive influence over the protoplasm of septic ferments.

Refrigerants, however, are popularly held to be those drugs which relieve the thirst of the fever-stricken patient, by moistening his dry lips and cooling his parched tongue. Ice or iced drinks manifestly fulfil these indications; and acids, which are often the most grateful of all, act very efficiently by directly stimulating the salivary secretion. R. FARQUHARSON.

**REGIMEN** (*rego*, I govern).—This word is not uncommonly used as synonymous with hygienic management. In a more restricted sense it is applied to the regulation of diet, both in health and disease. *See* DIET; and PERSONAL HEALTH.

**REGURGITATION** (*re-*, again, and *gurgito*, I swallow).—This word is technically applied to the reversal of the natural direction in which the current or contents flow through a tube or cavity of the body. Thus the food may regurgitate from the stomach into the œsophagus and mouth; the bile from the duodenum into the stomach; and blood from the aorta or pulmonary artery into the ventricles, from the ventricles into the auricles, or from the heart into the veins, when the respective valves are incompetent. *See* HEART, VALVES OF, Diseases of; and RUMINATION.

**REHME** (Oeynhausen), in Germany.—Gaseous thermal salt waters. *See* MINERAL WATERS.

**REICHENHALL,** in the Bavarian Alps. Common salt waters. *See* MINERAL WATERS.

**REINERZ,** in German Silesia.—Iron waters. *See* MINERAL WATERS.

**RELAPSE** (*re-*, back, and *labor*, I slip).—The return of a disease, which has apparently ceased, during or immediately after convalescence; or of a particular symptom in the course of a disease. Relapses are well exemplified in typhoid fever and acute rheumatism.

**RELAPSING FEVER.**—SYNON.: Famine Fever (Irish writers); Fr. *Fièvre à rechute*; Ger. *Hungerpest.* Also many other names, according to the localities where it has prevailed as an epidemic.

DEFINITION.—A continued contagious fever; characterised by absence of eruption, and a tendency to relapse at intervals of from five to seven days, and for an indefinite number of times; and generally occurring as an epidemic.

All medical writers, from the earliest times,

recognise the existence of a relapsing form of continued fever; but this disease had until recent years been included under the general term 'Continued fever.' Even in the great Irish famine fever of 1847, many of the Dublin physicians did not sufficiently distinguish between typhus and relapsing fever; and we find a statement often made that the fever relapsed into typhus, or that typhus relapsed into a form without spots. There is no doubt that typhus and relapsing fever co-existed at the time of the Irish famine, as they have invariably done at all times and places in seasons of great scarcity.

Geographical Distribution.—Northern Europe seems to be the favourite habitat of relapsing fever. It has been met with in America, but not as an epidemic, having been imported from Europe, and not showing a tendency to spread. An epidemic outbreak occurred at Peshawur in the Punjab, and also in Egypt. Epidemics have been more common in the British Isles than elsewhere. The most extensive epidemics have arisen in Ireland in times of famine, and extended thence to England and Scotland. An epidemic was confined to Scotland in 1843, and another to London in 1868.

Ætiology. — *Predisposing causes.* — Males suffer more from relapsing fever than females, in the proportion of about 1·5 to 1. The disease is most common between the ages of fifteen and twenty-five. Season seems to have little effect, but it appears to be more prevalent in winter than at other seasons, because the other predisposing causes are more intense at that time of the year. All the causes which predispose to contagious zymotics favour more or less the prevalence of relapsing fever. The most powerful, however, are scarcity of food, overcrowding, and want of cleanliness.

*Exciting causes.*—Relapsing fever is contagious, and has always been found to spread in proportion to the facilities for communication. It has been transported from long distances by affected persons; attacks attendants on the sick, and persons not predisposed when they are exposed to its contagion; and may be communicated by fomites. It seems to act through but a short distance. The period of incubation is uncertain, sometimes being apparently almost absent, at other times stated to extend to fourteen or twenty-one days.

Famine and its consequences, or famine alone, is a cause for the origin of relapsing fever *de novo*. Some doubt the truth of this statement, but it is usually received by writers upon the disease. The evidence in favour of famine as a cause rests upon the 'fact that after it has been absent for many years, it breaks out on each occasion under precisely similar circumstances' (Murchison). The circumstances preceding an outbreak are invariably failure of crops, and consequent famine. Relapsing fever, although usually prevailing among overcrowded persons in large towns, must not be considered to depend upon this condition, except so far as overcrowding favours the spread of contagion. The overcrowding in towns during an epidemic results from the same cause as that producing the fever; namely, the scarcity of food in the country, which drives people into the towns.

Anatomical Characters.—These are not marked, except where complications have caused death. The liver and spleen are both found enlarged in all cases, especially the latter organ. The digestive organs exhibit nothing particular, except in those cases where there has been long deprivation of food, or where dysentery or diarrhœa has accompanied or preceded the disease. Certain small bodies termed spirilla have been found in the blood of patients suffering from relapsing fever; these bodies decrease as the paroxysms subside, and are absent during the intermissions. Spirilla were discovered by Obermeier, of Berlin, in 1872, and the discovery was further confirmed by Engel in 1873. Spirilla vary considerably in number in different cases and at different times. They are constant in size, and form spiral fibrils, of which the convolutions are extremely small; the spiral form remains after all motion has ceased. Their movements are of three kinds—undulations passing along the whole fibril, flexions occurring at various points, and locomotive movements. These variations sometimes give the bodies a circular appearance, a figure-of-8 shape, or an arrangement in long chains. Large colourless transparent cells, in some cases from two to four times the size of colourless blood-corpuscles, are also found in the blood in relapsing fever. *See* Spirillum.

Symptoms.—The invasion of the disease is usually marked by rigors, frequently of a trivial character, amounting only to slight chilliness. This is followed by debility and giddiness; extreme weakness is not so marked as in the early stages of other forms of continued fever. There is headache, followed after a few hours by hot skin; the temperature rises to about 105° F., or sometimes, it is stated, as high as 108°; the pulse rises to from 110 to 130, occasionally counting 140 at an early stage of the disease. The tongue is covered with a moist creamy fur, which in severe cases becomes brown and dry in the centre, and in the worst forms becomes black all over. There is great thirst, as in all febrile diseases; loss of appetite; some abdominal tenderness, especially in the epigastric region; occasionally nausea, and more rarely vomiting; the bowels are usually confined, but in some cases diarrhœa prevails. In such cases the diarrhœa is of a dysenteric character, and is probably due to the dysenteric tendency which usually prevails in time of famine, when relapsing fever is prevalent. The skin generally presents a jaundiced hue; and careful examination will detect more or less enlargement of the liver and spleen. There is great muscular and articular pain. The pain in the back is frequently of the most intense character. Headache is more complained of than in the other forms of fever. There is sometimes, but not as a rule, delirium towards the end of the first week. In from five to seven days from the invasion of the disease, the symptoms suddenly subside, and the patient quickly becomes convalescent, being for the time apparently well. This convalescence is frequently accompanied or preceded by a critical evacuation from the bowels, kidneys, or uterus, or by profuse diaphoresis. It may be permanent, but more commonly the patient remains well for a few days or a week, and then suddenly relapses, and passes through all

the symptoms previously detailed. There may be a second or a third relapse, and even a fourth has been recorded. At no time during the progress of the disease is any specific eruption developed, although on the second or third day a reddish mottled rash has been met with, which, however, is irregular in its appearance, development, and duration, and usually terminates in desquamation. Purpuric spots have been sometimes, and sudamina very frequently met with.

Complications.—Pulmonary complications are not so common in relapsing fever as in typhus or enteric fever. Bronchitis, pneumonia, and laryngitis may occur, especially bronchitis, but these complications are not severe. Cardiac, arterial, or venous affections are rare, with the exception of hæmorrhages, which must be considered as being connected with the purpuric tendency which usually prevails in times of scarcity. Nervous complications are more rare than in any other form of adynamic fever. Dysentery and diarrhœa in some epidemics have proved to be most serious complications, and are of frequent occurrence whenever relapsing fever prevails. Abscess and other suppurative forms of inflammation are not common. In pregnant females attacked by this fever abortion usually occurs at an early stage; and premature labour, with death of the fœtus, and considerable danger to the mother, in the later stages of pregnancy. Death of the mother has sometimes happened from *post-partum* hæmorrhage.

Diagnosis.—Relapsing fever is most likely to be mistaken for other forms of continued fever, and may be confounded with the eruptive fevers in their earlier stages, especially small-pox. It differs from typhus in having a higher temperature and quicker pulse at the outset; in the absence of the specific eruption, of the extremely heavy aspect of the patient, and of the delirium of typhus; in the presence of extreme pains in the back, vomiting, and jaundiced tinge of the skin; and finally in the sudden cessation of symptoms, and the tendency to relapse.

It differs from enteric fever in the suddenness of its onset, enteric fever having a slow invasion; the want of the marked and extensive daily variations in temperature; the absence of the characteristic abdominal symptoms and eruption; and the absence of the localised iliac tenderness and the peculiar diarrhœa of enteric fever. The tongue also serves to distinguish relapsing from enteric fever; in the latter having a well-marked red tip and edges, in the former a light covering fur. Relapsing fever at its commencement has been confounded with small-pox, on account of the extreme pain in the back and marked vomiting which accompany both these diseases, but the appearance of the specific eruption will soon decide the question.

Prognosis, Duration, Terminations, and Mortality.—The prognosis of relapsing fever is usually favourable, the mortality being low, from 1·2 to 2 per cent. in London, up to 4 and 4·5 per cent. in other places; the average rate being about 4 per cent. The chief causes influencing the rate of mortality seem to be the prior state of the patient, and the duration of the disease before medical relief is applied for. Purpuric symptoms, severe dysentery or diarrhœa, serious hæmorrhages, or extensive chest-complications, always indicate a grave prognosis.

Treatment.—The treatment of the disease must be preventive and curative. The chief promoting causes of the disease being famine and contagion, the means for prophylaxis are obvious. The active treatment must chiefly be directed towards the relief of symptoms, and sustaining the strength of the patient. The use of quinine and mineral acids in the earlier stages, and a plentiful supply of light and nourishing food in the later, will be found sufficient. A considerable amount of the success of treatment must depend upon the dieting of the patient. It must be kept in mind that most of these patients have been in a state of starvation. It will be necessary, therefore, to carefully and gradually increase the supply of food. The food at first must be of a most digestible and fluid kind, which may gradually be altered to a diet of a more solid and general character. Dysentery has not infrequently been caused by the sudden feeding of patients suffering from relapsing fever in its early stages. Milk, light starchy puddings made with milk, thin custards, and finally chicken, chops, and general diet will be found the best course in this disease. Stimulants may be occasionally requisite, but are seldom necessary in any quantity, or for a length of time.

T. W. Grimshaw.

**RELAXATION**
**RELAXED** } (*re-*, again, and *laxo*, I loose).—These words signify a condition of looseness, and are used somewhat vaguely in a variety of associations. Thus we speak of *general relaxation*, to express a want of muscular tone or vigor. *Local relaxation* refers to a condition of abnormal looseness of a part, as of the joints, muscles, the uvula, or the throat, which are then said to be *relaxed*. Another signification of the term relaxation is that of looseness of the bowels, as in diarrhœa.

**REMEDY** (*remedium*, a cure).—A remedy properly signifies a therapeutic agent which possesses a recognised influence in preventing, relieving, or removing a particular morbid condition. Thus vaccination is a remedy for small-pox; quinine for ague; mercury and iodide of potassium for syphilis; and opium for pain. *See* Disease, Treatment of.

**REMISSION**
**REMITTENT** } *re-*, again, and *mitto*, I send).—A disease is said to be remittent when it is characterised by periodical diminutions of symptoms, followed by exacerbations, as in remittent fever and neuralgia. The period during which the symptoms are in abeyance is called a *remission*. *See* Remittent Fever.

**REMITTENT FEVER.**—Synon.: Bilious Remittent; Fr. *Fièvre rémittente*; Ger. *Bösartiges Endemisches Fieber*.

Definition.—A paroxysmal fever of malarial origin, in which the paroxysms do not intermit, but only, as the name implies, remit.

General Observations.—Remittent fever is the most severe of the class to which it belongs; it is a more acute affection than inter-

mittent fever, more severe in its symptoms, more rapid in its course, and the direct mortality is ten times greater than in any other form of malarial fever. It is commonly known in India as *jungle fever*, because it is in jungles there at certain seasons of the year that it is most frequently contracted. It often obtains local names derived from places notorious for producing it, a practice productive only of confusion and misapprehension. It is sometimes said to hold a middle place between intermittent and continued fever; the more nearly it resembles the latter, the more dangerous it is. In other words, the less distinct the periods of remission, and the longer the stage of exacerbation, with its high temperature, and other disturbances of the system which characterise that stage, the greater is the risk of such blood- and organic changes as are incompatible with life.

Remittent fever is usually seen in its gravest forms in hot climates, but has often been very fatal in malarial regions in temperate climates, as in Walcheren. This, in unhealthy countries, is often the first form of fever that attacks new-comers, but such are seldom exposed to second attacks; in other words, there is in this type less tendency to a recurrence of the disease than in the intermitting form. It may be that the extremely energetic character of the symptoms in the remittent type is more effectual in destroying, altering, or 'eliminating' the poison, than the milder intermittent attack. In 1865, out of 3,199 cases of remittent fever admitted into the military hospitals of Algeria, only 359 had second attacks; while out of 15,080 cases of intermittent fevers, 4,295 were re-admitted with the same type of fever (*Statistique Médicale de l'Armée*, 1865). The medical officers of our army in Spain observed that their men, on entering a malarial locality, generally suffered severely from the remittent form, while the inhabitants of the country were only affected by the intermittent type. Survivors, however, who remain in the locality, become, like the inhabitants, only liable to the milder type of the disease.

Ætiology.—Remittent fever is found whenever its specific cause is generated in sufficient concentration to cause it. This will probably be found to correspond with the germ origin of intermittent fever (*see* Intermittent Fever; and Malaria). It prevails in the malarial parts of the Old and New World. Our armies have suffered from it both in temperate and hot climates; in the East and West Indies, and, with extreme malignity, on the West Coast of Africa. It is a common disease in the malarious parts of Italy; and the French army has suffered much from it in Algeria. It is seen in the deltas of great rivers, in the *terrais* of India, in jungles, and in other districts in the same country long left uncultivated.

Anatomical Characters.—The morbid anatomy of remittent fever is the same as in intermittent fever; the difference is only in degree. Congestion of the mucous coat of the stomach and duodenum, with softening, is more marked than in other types of malarial fever, as well as enlargement of Brünner's glands. The pigmentary degeneration of the spleen and liver is more intense, often extending also to the brain and spinal cord, giving them a bronzed appearance.

Symptoms.—**Premonitory.**—These are much the same as in a severe intermittent.

**Cold Stage.**—The term is hardly applicable in this fever; the patient is sensible only of a slight sensation of chilliness, which very rarely passes into rigors. Nevertheless, the thermometer indicates a temperature above the normal, and in the hot stage this quickly rises to 106°, 107°, and sometimes to 110° F.

**Hot Stage.**—As this develops, the whole system is profoundly disturbed. There is the high temperature already indicated, which, when fully developed in the worst cases, approaches within three degrees of that in which the albuminoid constituents of the muscular tissue begin to coagulate. This grave symptom is seen in its utmost intensity in those who have exposed themselves, perhaps after indulging in alcoholic liquor, to a powerful sun, without reasonable precautions. With this there is necessarily pungent heat of skin; an intensely flushed face; severe headache; pain in the back and limbs; quick respiration; a pulse of 120 or more; a foul, dry, and bile-tinted tongue; a sense of oppression at the epigastrium, with fulness and tension in that region; and violent vomiting, which brings no relief to the gastric oppression.

This vomiting is one of the most distressing symptoms; the quantity of fluid vomited far exceeds what has been taken by the patient; at first it is colourless, then bilious, and sometimes bloody. In pernicious cases it closely resembles the 'black vomit' of specific yellow fever. With the above symptoms there is an anxious countenance, and much restlessness. In this condition the patient remains from six to twelve hours. Then the more urgent symptoms abate; the temperature falls two, three, or more degrees; the skin becomes slightly moist, far short of the profuse sweating in an intermittent fever; headache sensibly diminishes; and the nausea, vomiting, and epigastric tension either cease or sensibly abate. This is the *remission*, always anxiously looked for, not only as a relief to the patient, but as a precious time for treatment. In bad cases, when the other symptoms remit so little as to escape the notice of all but an experienced observer, the thermometer will indicate at least an attempt at a remission. This lasts from two to twelve hours; the longer it is, the more favourable is the prognosis. A feeling of chilliness then returns, quickly followed by the hot stage, with all its distressing symptoms. This is the *exacerbation* of systematic authors, which in its turn gives way to the remission.

A morning remission in this fever is so invariable as to be a point of diagnostic value, and it is an old rule in military practice so to time the morning visit as to insure seeing the patient while it lasts. The exacerbation usually returns about noon, and in severe cases lasts till midnight. Sometimes two exacerbations occur, one at noon, the other at midnight, with a slight evening, and more distinct morning, remission.

The *skin* sometimes assumes a yellow tint, and if there be with this anything resembling black vomit, a false diagnosis of yellow fever may be made. The term 'yellow remittent' is

correctly enough applied to such cases, but the resemblance between these and cases of specific yellow fever is only superficial.

*Hiccough* is a troublesome symptom, and if it appears late in the disease, and continues during the remission, is not a favourable one.

The *bowels* are usually constipated, but in pernicious cases the motions sometimes become very loose, bloody and offensive, a condition of evil omen.

*Jaundice* is rare, although, as already said, the skin has often a yellowish tinge, more dependent on blood-changes than from an icteric cause.

*Hepatitis.*—The only cases of suppurative inflammation of the liver, occurring in the course of remittent fever, that have come under the writer's observation, were brought to Netley from the Gold Coast, where this serious complication appears common.

*Delirium.*—Except in men who have lived imprudently, and, in addition to the poison of malaria, have indulged freely in alcohol, active delirium is rare. Like in all malarial fevers, the symptoms and lesions in remittents point more to implication of the abdominal organs than of the nerve-centres.

The *urine* is acid, scanty and high-coloured, rarely albuminous—so rarely, that its absence is a point of diagnosis between malarial remittent and specific yellow fever. During the hot stage the secretion of urea is greatly increased, but lessened when convalescence sets in. In two very severe cases treated by the writer in India, there was profuse secretion of bloody urine throughout, which lasted until convalescence set in.

The *adynamic form* of remittent fever is one of great gravity. It is becoming every day more apparent that in bygone years—and perhaps even now in India—cases of enteric fever have been, and are, mistaken for malarial remittent. The diagnosis is not so easy as it may appear to those who are familiar with enteric fever pure and simple, as seen in temperate climates. There are cases of a mixed nature, in which a thread of malaria, so to speak, runs through the symptoms and obscures them. The term 'typho-malarial' has come into use in India to distinguish this class of cases, which are as difficult to treat successfully as to diagnose clearly. French and Italian writers would apply their favourite term 'pernicious' to such cases, which are characterised from an early stage by great prostration; brief and uncertain remissions; a quick and compressible pulse; a black and dry tongue, the teeth being covered with sordes; rapid respiration; epigastric tension and oppression; the bowels being loose, and the motions bloody, with a disposition to hæmorrhage from the mucous surfaces generally. Such cases are often fatal, and *post-mortem* examination, in addition to the common lesions of malarial fever, reveals ulceration of Peyer's patches.

Duration.—The duration of a remittent fever is from five to fourteen days; but, as in all miasmatic fevers, it is much affected by the action of remedies. In the worst forms death is rare before the eighth day.

Diagnosis.—1. From *specific yellow fever*.—Remittent is paroxysmal; yellow fever is continued. Remittent has a morning remission; yellow fever has not. Hæmorrhage from any source is exceptional in remittent; in yellow fever it proceeds from mouth, nose, eyes, ears, bowels, and even the urinary passages. Even in the worst remittents albuminous urine is rare; it is the rule in yellow fever. Over remittent fever the power of quinine is beyond question; the drug is powerless in yellow fever. Death in the worst remittents is never seen before the eighth day; in specific yellow fever it is common on the third day. The mortality rate in yellow fever is often forty per cent. of those affected; that of remittent does not in ordinary circumstances exceed four or five per cent., and is often less. Yellow fever is portable and contagious; remittent is neither. Yellow fever has a special *habitat* of its own, and can only exist as an endemic disease in countries where the mean temperature does not fall below 72° F. Lastly, specific yellow fever has never established a footing on the shores of India, where malarial remittent is an endemic disease.

2. *Enteric fever*, pure and simple, ought not to be easily confounded with remittent. It is marked off by the difference in the thermometric curve: in enteric fever, the rise of temperature is slow; in remittents it attains its maximum in a few hours. There is also the characteristic eruption, the iliac gurgling, and the peculiar stools of typhoid, all absent in remittent. As mentioned above, the diagnosis is not so easy when the peculiar symptoms of malarial mask or obscure those of enteric fever. Still, due observation of the peculiar combination of symptoms will enable careful practitioners to make a good practical diagnosis, and to regulate their treatment accordingly. It may seem unscientific to speak of two specific diseases existing together, and as it were struggling for the mastery in the system. The writer's belief is, that in the doubtful cases the real disease is enteric fever, the symptoms being merely modified by malaria, in the same way as they are in many other diseases.

Prognosis.—This is favourable when the remissions are distinct; when each succeeding exacerbation diminishes in force; when the skin acts freely; and when the urine deposits the sediment described as critical in intermittent fever as the attacks pass off.

Faint and uncertain remissions; a tendency to collapse at the close of an exacerbation; the sudden setting in of dangerous complications; the predominance of typhoid symptoms; suppression of urine; and a general disposition to hæmorrhage from the mucous surfaces, are all signs of evil omen.

Treatment.—After a large experience in the treatment of malarial fevers in some of the most unhealthy regions in the East, the writer desires to place on record the fact that he has never seen any but disastrous results from treatment based on the belief that remittent fever is an inflammatory disease. The practitioner who keeps this in view, and acts on the principle of saving power as much as possible, will save more lives than the man who, alarmed by the violent disturbance of the system, attempts to calm it by lowering treatment · or the other, who, halting

between two opinions, seeks to cure his patients by an incompatible mixture of depressing and conservative remedies. With the reservations already given when treating of intermittent fever, no better combination of a purgative with quinine can be given, to begin the treatment, than Livingstone's, described in the article on that disease; but whatever be the purgative selected, it should be suited to bring away copious bilious discharges, which will greatly mitigate the vomiting, and it should be combined with quinine. A good formula is from 3 to 5 grains of calomel, compound extract of colocynth, and powder of scammony, with a drop or two of any aromatic oil; this acts effectually on the whole tract of the intestine, usually without nausea or griping, and a like quantity of quinine may be added.

Two courses are now open to the practitioner. One is to postpone the further administration of quinine until the first remission. In the other the exacerbation is disregarded, and quinine is given in full and effective doses at once. If the first plan be decided on, much may be done to promote the comfort of the patient, to lower the temperature, and thus to hasten the period of remission. In strong men, when the temperature is high, exceeding 105° Fahr., with headache, violent action of the heart, rapid respiration, oppression and restlessness, drop doses of the tincture of aconite every quarter of an hour until ten or twelve doses have been taken, calm the patient, reduce the force of the heart's action, assuage the headache, and sometimes in a marked manner relieve urgent and distressing symptoms. Used in this way, and its effects watched, aconite is a valuable and safe remedy, and, acting in the same way, it is as useful in specific yellow fever. It has also this great recommendation, if cautiously used, that it leaves no sting behind.

When the temperature rises, as it often does, to 105–6° or 110°, more energetic means are called for. The patient should be placed in a bath at 90° Fahr., which should be cooled down until the thermometer indicates a temperature 15° below the normal temperature of his body. The effect of this in calming the patient, relieving the oppression, and checking vomiting, is often very striking. When removed from the bath the patient should be wrapped in a blanket. In adynamic cases, where the use of the bath is not deemed prudent, the same good effects may be brought about by sponging the surface with water, the temperature of which is gradually reduced as directed above.

On the first appearance of the remission quinine must be given by the mouth, bowel, or skin. If there is no vomiting, by the mouth; if the remedy will not remain on the stomach, then it must be given by bowel or skin. Of the inconveniences and occasional danger of the latter method, the writer has spoken in the article INTERMITTENT FEVER, to which the reader is referred. If the hypodermic method is ever justifiable, in the face of the danger of inducing tetanus in the manner described, it is in the grave and pernicious forms of this disease, when life is threatened, and time presses. If the remedy is given by mouth or rectum, at least half a drachm should be introduced into the system during the remission. It is in remittent fever of the urgent kind under notice that the Tinctura Warburgi already mentioned (*see* INTERMITTENT FEVER) is most useful. As is now well known, the active ingredient in this remedy is quinine; and, if used as directed in the article referred to, it is as safe as it is effective. American physicians appear, in treating this disease, to follow chiefly the second plan mentioned, and trusting to the known property of quinine to diminish and not to increase temperature, they give it during the hot stage. The great difficulty here is the vomiting; during the exacerbation it is almost impossible to get anything to remain on the stomach. It must then be administered by enema to the extent of half a drachm, half the quantity being given in the same way three hours before the return of the exacerbations. Full doses of from 15 to 20 grains of the bromide of potassium at bedtime tend to calm restlessness and promote sleep. The above treatment must be persistently followed day by day until the fever is overcome.

It will be seen from the above remarks that obstinate vomiting is not only a source of extreme and exhausting distress to the patient, but also one of the chief embarrassments of the practitioner. The means advised above are often effectual in checking it, and they may be supplemented by the use of ice when available, by external stimulants over the stomach, or by the application of cloths sprinkled with chloroform over the same region. Drop doses of Fowler's solution of arsenic have been found by Bellot the younger effective in checking this distressing symptom in yellow fever, and the same remedy may possibly be of use in cases resisting other means. But in the writer's experience vomiting, as a rule, subsides with the other symptoms, when the exacerbations are controlled by quinine. What was said, under the head of intermittent fever, of the danger of pausing in the use of quinine, to treat this or that complication, is most emphatically repeated here.

On the first sign of collapse in any stage, recourse must be had to stimulants; white wine whey is an excellent vehicle for the administration of alcohol, if that be called for; good champagne, if available, or the best Rhenish wine within reach, often answer admirably, and are keenly relished. Livingstone's party used bitter ale, and speak in praise of it as a stimulant grateful to the patient, 'frequently remaining on the stomach when all others are rejected.' The large experience of such intelligent observers on such a subject is worthy of respect. It is hardly necessary to dwell on the necessity of sustaining the patient during the remission by a diet adapted to the irritable condition of the stomach. With one remark—one pregnant remark by the Rev. Horace Waller, the fellow-traveller, friend, and biographer of the illustrious Livingstone—we shall close this article: 'One thing, however, must be strongly urged: it is that all notions about not being able to "stand quinine," that it "flies to the head," and so forth, must be banished as utter nonsense. In Africa everyone can stand quinine; there is scarcely a disorder there in which it is not positively required.' The

writer adds from his experience that this is as true of malarial regions in other parts of the world as it is of Africa. W. C. Maclean.

**REMOTE CAUSES.**—This expression is used as a synonym for predisposing causes. *See* Disease, Causes of; and Predisposition to Disease.

**RENAL CALCULUS.**—Synon.: Nephrolithiasis; Fr. *Calcul rénal*; Ger. *Nierenstein.*

Definition.—A concretion formed by the deposit of one or more of the solid constituents of the urine. It differs only in size from the gritty particles called 'gravel'; it may be single, or there may be many; it may be present in one or both kidneys at the same time; and it occurs at all periods of life, from the fœtus *in utero* up to the extremest age.

Ætiology.—The majority of urinary calculi are primarily formed in the infundibula or uriniferous tubes of the kidney; and are caused by precipitation, in the nascent state, of uric acid or oxalate of lime. This precipitation may be due to a real excess of the insoluble uric acid, or to deficiency of the water of the urine; but the precise form and proximate cause of the deposit are determined by the presence of a colloid matrix, composed of mucus or blood-globules, or other animal basis (*see* Calculus). Increase by gradual accretion goes slowly on until blockage of the duct occurs; the calculus is then either floated by the urinary stream into the pelvis of the kidney and onwards through the ureter, or it becomes impacted in some part of its transit and develops into a full-formed renal stone, which, minute at first, may grow to enormous proportions.

Varieties.— By far the most frequent variety of renal calculus in this country is that composed of uric acid; in the eastern counties, where stone is most common, it is very rare indeed to find in the adult any other primary form. Even in children, in whom oxalate of lime is not uncommon, uric acid is the most prevalent. It is thought by some pathologists that oxalate of lime forms the first starting-point even of uric acid stones, but this statement lacks proof. The sparing solubility of uric acid and oxalate of lime is probably the cause of their greater frequency in calculi; but other agents may occasionally be found to constitute the primary nucleus of renal stone, such as cystine, carbonate of lime, phosphate of lime, either by itself or in combination with the ammonio-magnesian phosphate, forming what is designated the fusible calculus, and urate of ammonia or the mixed urates. The phosphates and urates, however, are more likely to occur as secondary than as primary deposits. Mixed or alternating calculi are frequently met with, in which are seen alternate strata or layers of uric acid, oxalate of lime, and phosphates, the latter generally constituting the external part.

Pathological Effects.—The action of a calculus on the structure and condition of the kidney depends much on its size. At first it may produce irritation and local congestion, possibly leading to actual inflammation, and even abscess within or external to the capsule. This may happen when the stone develops in the tubular or secreting structure; but when it remains and enlarges in the pelvis of the kidney, chronic pyelitis is more likely to ensue, with changes of an atrophic character. The pelvis dilates; pressure comes to be slowly exerted on the renal structure, causing wasting, until but little secreting tissue is left; and a large stone remains, occupying the pelvis and branching into the calyces, in shape resembling a cauliflower, and with little covering beyond the capsule of the kidney.

Symptoms.—The genesis of renal concretions is always unrevealed by symptoms; their retention and development up to a considerable size or in great numbers may be unsuspected and unnoticed; and even their transit and escape through the urinary passages may be painless. Usually, however, there is some degree of lumbar pain, generally restricted to the side affected, spreading more or less to the front of the body, and down towards the groin and bladder. The pain is apt to be aggravated by exercise—especially by carriage exercise, and it is liable on such occasions to become very severe; so also when, from any cause, it is disturbed in its bed, or makes a fruitless attempt to enter the ureter (renal colic).

When a stone of some magnitude is passing down the ureter, symptoms of a very acute character usually ensue. The pain rises to intense agony in the loin, and along the course of the ureter down to the bladder and testicle; frequently there is sickness or vomiting; the patient is bathed in warm perspiration; and he sometimes passes into a state of fainting and collapse. The bladder is frequently irritable; the urine is smoky from the presence of blood, or of elongated clots; or almost pure blood escapes. These symptoms may come on suddenly; may last a few hours or a few days; and may end as suddenly when the calculus reaches the bladder.

The changes produced in the urine by renal calculus may be very slight. Hæmorrhage is the most common and most characteristic; sometimes it is in quantity enough to render the urine smoky or like porter; at other times it can only be detected by the microscope. When it exists in any palpable amount, albumen will, of course, be present too. Pus, mucus, and epithelium corpuscles will show themselves when the calculus has produced some degree of pyelitis. In long-standing cases a tumour may be felt in the situation of the kidney. The patient resting on his back, and the knees being drawn up, the surgeon with one hand behind presses the kidney forwards, and with the other in front presses it backwards below the margin of the ribs. He may thus, in young and thin persons—aided, perhaps, by the administration of ether—differentiate a renal stone from any of the usual kinds of renal tumours.

Diagnosis.—Renal calculus may be mistaken for various diseases:—1. Bilious attacks, intestinal colic, or perityphlitis. The sickness and pain in the flank are present in all, but in nephritic colic the pain is apt to be more located in the loin, although this is by no means always so. The presence of hæmaturia will be conclusive. In typhlitis and perityphlitis there will be fever and local tenderness. 2. Obscure pain in the back, due to chronic lumbago or neuralgia. In these conditions the pain is generally across

the back, and not unilateral; it is aggravated by movements of the affected muscles; and there is no hæmaturia or other urinary complication. 3. Cancer or other renal tumour. Pain and hæmaturia are characteristic of both stone and cancer, but in calculus the health is generally good, while in cancer it is always deteriorated. In stone there is seldom any tumour, and when it does exist it must be of limited size and hard, whereas in cancer it is diffused and may be soft.

Prognosis. — The frequent formation and escape of renal stones may continue for a great many years without any material injury to the general health. Even when blockage of the ureter takes place, leading to hydronephrosis and atrophy of the organ, or to nephritis or perinephritis with abscess, a fair measure of health may be preserved, provided the other kidney is in a healthy condition. When both organs are affected, or when complications arise, such as amyloid or tubercular disease, or chronic pyelitis, then the health steadily deteriorates, emaciation proceeds, with hectic and fatal exhaustion.

Treatment.—Bearing in mind that the large majority of renal stones are composed of uric acid, and that it is not difficult to form a correct diagnosis on this point, it will be necessary chiefly to consider the treatment of this form of concretion. Preventive treatment consists in a rigid limitation as to the *quantity* of food taken. It is customary to condemn a free use of animal food and highly-seasoned dishes; but it should be borne in mind that stone prevails largely amongst the poor, who seldom can indulge in animal food to excess, and it is not unfrequent in countries where no animal food is taken. Far more important is it, both as to food and drink, to observe a strict moderation as to the amount taken. In this way digestion and assimilation will be easy and perfect; crude matters will not find their way into the blood; the chemical conversion of uric acid will be complete; and precipitation in the uriniferous tubes will be obviated. When the proclivity to uric acid calculi is decided, or when a small stone is known to exist, the free use of diluents and alkaline remedies is undoubtedly of importance. The waters of Vichy, Ems, and Neuenahr, taken freely at the springs, with or without baths, but with the great aid of change of air and mode of life, constitute the most efficient plan of treatment; but it must be admitted that in the majority of cases this good effect is only transient. Some high authorities recommend, in preference to the simple alkaline treatment, the use of those saline aperient waters whose chief ingredient is sulphate of soda, such as Carlsbad and Friedrichshall; and undoubtedly they have a most beneficial action, by promoting digestion and assimilation. But as with the alkaline remedies, whether natural waters or drugs, so with the salines, their action is evanescent. Leave them off and let the patient return, perhaps to a place where calculus is frequent, or to habits of careless living, or to over-work, and the morbid tendency will almost certainly recur. If there are clear indications of the actual presence of a renal stone, composed of uric acid, of moderate size and recent date, the solvent treatment, as described by Dr. Wm. Roberts, should be fully carried out. It depends for its success on the known solubility of uric acid and its salts in alkaline solutions of definite strength, the most efficient being about 60 grains to the pint; above and below this strength the solvent power diminishes. The patient, if an adult, should take 40 to 50 grains of the acetate or citrate of potash in 3 or 4 ozs. of water every three hours during the day, and once at least in the night; this plan should be continued for two or three months. During the treatment the urine should be frequently examined, and if any approach to an ammoniacal state should appear, the treatment must be suspended for a time. The effect of the treatment must be estimated by the diminution of lumbar pain, and by the escape of small calculi; no ill-effects are caused; seldom any indigestion; and no impairment of general health. Other drugs have been employed for the solution of uric acid, such as carbonate of lithia, phosphate of soda, tartrates and carbonate of potash and soda, and carbonate of lime. Some years ago the writer conducted some experiments with prepared chalk, and found that, when given to the extent of 20 to 30 grains in mucilage and mint water, three or four times a day, it had a most marked effect in quickly removing uric acid deposits, and it will have this effect even in the febrile state. It did not, in the quantities given, produce alkalinity of the urine, but it acted distinctly as a diuretic.

In the crisis of nephritic colic, narcotics are called for, in doses large enough and frequent enough to control the pain. If sickness is troublesome, morphia may be administered subcutaneously, and if there be vesical irritation, by suppository. If the agony be extreme and in paroxysms, chloroform may be inhaled occasionally; while the hot bath, anodyne fomentations, and stupes are useful aids to relieve and soothe.

Surgical treatment of renal stone is coming prominently into notice at the present time. Incision in the lumbar region and removal of stone from the kidney is as old as Hippocrates; and when abscess and sinus exist, leading to a stone impacted in the kidney, or when a lumbar swelling is present which is obviously caused by a renal stone, an exploratory incision for its removal is clearly warranted, and has been successful in several instances. So, too, has the entire extirpation of a kidney containing calculi, as well as for other diseases of the organ. For the conditions which justify and call for these operations, and for the steps to be taken in their execution, the records of surgery must be consulted.

Wm. Cadge.

**RENAL COLIC.** — Synon.: *Nephralgia calculosa*; Fr. *Colique néphrétique*; Ger. *Nierenschmerzen*.—The name commonly applied to the symptoms which arise when a renal calculus either passes, or attempts to pass, down the ureter. *See* Renal Calculus.

**RENAL DISEASES.**—*See* Kidneys, Diseases of.

**RESISTANCE.**—The sensation recognised by the fingers, of the degree to which a part yields or resists when palpation or percussion is being performed. *See* Physical Examination.

**RESOLUTION** (*resolvo*, I loose).—The return of a diseased part to its natural condition; chiefly applied to the process of inflammation when it subsides gradually, and without the occurrence of suppuration or other unfavourable termination. *See* INFLAMMATION.

**RESOLVENTS** (*resolvo*, I loose).—Anything which aids the absorption of effused products may be included in this class of remedies; the most efficient being, externally, counter-irritation and poultices; and internally, mercury and iodide of potassium. Our knowledge of the precise mode of their action is still very vague. The subject of blisters and the like is considered under COUNTER-IRRITATION. It is generally held that mercury renders fibrin less cohesive; and that iodide of potassium—in virtue, probably, of the free iodine which is separated within the blood—has a special affinity for albuminous bodies, and for that form of lowly organised fibrin which is so commonly deposited in the tissues during the more advanced stages of constitutional syphilis. It is difficult, however, to discuss this therapeutical heading from a strictly scientific standpoint, deriving its origin as it does from a past epoch, when pathological science was still in its infancy, and when very active modes of treatment were held to possess virtues which further experience has not confirmed. Free bleeding and blistering, combined with copious salivation, were held in these days to have a most powerful influence in checking inflammation and removing its sequelæ; and we are only now learning to assign to unaided nature the due share which she takes in effecting what we are accustomed to call the 'cure' of disease.

R. FARQUHARSON.

**RESONANCE** (*resono*, I sound again, echo). Resonance signifies the character of the sound yielded on percussion over the greater part of the chest, and, within wide limits, of the abdomen also. The degree of resonance depends principally upon the proportion of air contained in the underlying cavities or organs. *Vocal resonance* is the voice-sound transmitted through the chest to the ear of the auscultator. It is increased or diminished in accordance with the physical conditions present in the chest-cavity.

*Hyper-resonance* is a term used to signify undue resonance over a given part.

*Deficient resonance* is commonly called *dulness*. It is often used with the same comparative or local application as hyper-resonance. *See* PHYSICAL EXAMINATION.

R. DOUGLAS POWELL.

**RESPIRATION, Disorders of.**—A due performance of the function of respiration is essential to the well-being of the economy, and any derangement of this function is likely to be followed by more or less disturbance of the system, varying in degree and gravity, but often of a serious character. Moreover, the phenomena resulting from such a derangement are commonly of much significance with reference to diagnosis, prognosis, and treatment. Therefore, disorders affecting breathing demand attentive and careful observation and consideration in every case; while their general study by no means receives the thought and attention which its importance emphatically requires. In a short article it will be impossible to do more than give a very condensed summary of the subject, and to suggest points for the further consideration of those who are interested in it. The several forms of disordered breathing associated with particular diseases are indicated in their appropriate articles.

Before considering the disorders of respiration, it will be well to call to mind the following points relating to the performance of the act in health. The average frequency of breathing is from sixteen to twenty per minute in adults, although this rate is easily disturbed temporarily by various physiological conditions. The function is powerfully under the influence of the nervous system, and it is ordinarily carried on either by centric or reflex stimulation, without any consciousness of the act on the part of the individual, and independent of any voluntary effort. In ordinary respiration scarcely any movement or other sign of the act is observable to an onlooker, and the actual quantity of air changed with each breath is very small, amounting only to from 16 to 20 cubic inches; but in this respect also the act is very liable to be disturbed, while a person is able voluntarily, without any difficulty, to breathe more or less deeply, performing 'extraordinary respiration,' and he may thus change large quantities of air, and call into play every part of his lungs. Remembering what respiration is intended for, the conditions required for its proper performance in connection with the breathing-apparatus are, that there should be a sufficient supply of air suitable for the purpose, and an adequate passage for its entrance and exit; that there should be enough healthy lung-tissue; that the blood should pass freely through the lungs, and be within certain limits of a proper quality; that there should be no mechanical impediment to the free working of the lungs, especially if suddenly called upon to do extra work; and that the forces by which the respiratory movements are carried on, namely, the muscles, including the diaphragm, and the elasticity of the lungs and chest-walls, are equal to their work. If the act of breathing is watched and investigated, it will be found that normally expiration is rather longer than inspiration; but there is no striking difference between the two divisions, the ratio being as twelve to ten in males, fourteen to ten in females. Moreover, the movements are both thoracic and abdominal, the former being distinctly made up of expansion and elevation during inspiration, of retraction and depression during expiration, especially when a full breath is taken. The intercostal spaces in most parts, as well as the supra-clavicular fossæ, seem to sink in during inspiration, so as to become more evident, this being more marked in proportion to the depth of the inspiration. It will further be noticed that the precise movements differ in different persons, and according to the extent of respiration. The lower ribs and diaphragm act principally in males and children during ordinary breathing; in adult females the respiration is upper costal. In extraordinary breathing the movements are chiefly upper thoracic in all persons.

Respiration is markedly influenced by physio-

logical conditions, such as exercise, diet, sleep, and various others; these must be remembered in considering its derangements.

With these introductory remarks, the disorders of respiration may now be more conveniently studied.

Ætiology and Pathology.—The numerous causes and conditions which lead to disturbances of respiration can be brought within well-defined groups, and it is desirable in the first instance to study them from such a general point of view. This, however, only gives a superficial insight into the subject, and does not indicate the kind of disorder that is produced by each cause, or how it acts, while many conditions act in more ways than one; and still further, in any individual case there may be more than one, perhaps several causes at work, all of which ought to be recognised. These causes and conditions may be summarised in the following manner, and it will be seen that several of them act indirectly on the respiratory process:—

1. *Conditions acting directly through the nervous system.*—These include:—(*a*) Centric lesions in connection with the brain, involving the respiratory centre, either directly or indirectly, such as injury, hæmorrhage, or a tumour. (*b*) Disease or injury of the upper part of the spinal cord, paralysing the nerves supplying the respiratory muscles. (*c*) Functional nervous disturbance, as from mere nervousness, emotion, hysteria, trance, or chorea. (*d*) Conditions affecting immediately the nerves concerned in respiration, either irritating or paralysing them, especially the pneumogastric, recurrent laryngeal, or phrenic nerves. These nerves may be themselves diseased, or affected by a neighbouring condition, such as a tumour. (*e*) Reflex causes, transmitted from the skin, as when cold water is dashed upon it; or from organs, as the stomach, intestines, or ovaries. It is important to remember that causes connected with the nervous system frequently aggravate disorders of breathing otherwise occasioned.

2. *Abnormal conditions of the blood.*—In this group are merely included conditions of the blood as a whole, and not any local derangement affecting the pulmonary circulation. They are:—(*a*) Deficient quantity of blood, especially from a sudden or rapid loss. (*b*) Anæmia or hydræmia. (*c*) Deficient aëration. (*d*) A poisoned, impure state of the blood in connection with narcotism, the anæsthetic state, pyrexia, the typhoid condition, uræmia, pyæmia or septicæmia, diabetes, and other diseases.

3. *Functional disorders, or organic diseases, connected with the heart.*—These are common sources of disturbance of breathing of various kinds, depending upon the intimate relation of the nerves and nerve-centres governing the heart and respiratory organs; upon the effects they produce as regards the pulmonary circulation; or sometimes upon their direct interference with the movements of breathing, by exerting pressure upon the lungs, especially the left, upon the left bronchus, or upon the chest-walls, particularly the diaphragm. This last cause is only noticed in cases of great enlargement of the heart, or of considerable pericardial effusion. The breathing, however, is frequently disturbed in connection with disorders of cardiac action; diseases of valves and orifices, especially the mitral and tricuspid; enlargements of the heart, particularly dilatation; degenerations; congenital malformations; and clotting of blood in the cavities of the heart.

4. *Abnormal conditions of the air inhaled.*—The physiological effects produced upon the respiratory act by various states of the air inspired are well known. These especially depend upon its composition; its temperature; and its condensation or degree of pressure. From a clinical point of view these deviations have to be borne in mind, as they are more liable to be induced in certain diseases, and may also be made available for therapeutic purposes.

5. *Conditions affecting the apparatus concerned in the respiratory movements.*—These refer to the chest-walls and the diaphragm, and they include:—(*a*) Certain painful affections, causing the patient to limit or modify the movements, such as the early stage of pleurisy, pleurodynia, or peritonitis. (*b*) Spasm or paralysis of the muscles, from any cause. (*c*) Organic changes, as undue softness or rigidity of the thoracic walls, cancerous infiltration, muscular atrophy or fatty degeneration, acute or chronic inflammation of the diaphragm.

6. *Obstruction involving the main air-passages.* This may be situated in the mouth, throat, larynx, trachea, or primary bronchial divisions, and is due to a variety of causes, which cannot be discussed here further than to state that the obstruction may depend upon pressure from without; spasm or paralysis of the muscles of the larynx; some internal obstruction, whether from deposits, secretion, foreign bodies, or new growths; or organic changes in the walls of the tubes, leading to their constriction.

7. *Physical conditions independent of the respiratory apparatus, but interfering with it in various ways.*—These may lie within the chest, as in the case of thoracic aneurism, or a mediastinal solid tumour or abscess. They act by compressing the lungs or heart, obstructing tubes, affecting nerves, or interfering with the moving apparatus. Or the cause of the disorder may lie in the abdomen, such as excessive flatulence or tympanites, abundant fluid in the peritoneum, enlarged organs, ovarian tumours, or a pregnant uterus. They act mainly mechanically, by impairing the movements of the diaphragm. Breathing often becomes worse after food, in consequence of dyspepsia leading to flatulent distension.

8. *Conditions affecting the pleuræ.*—Any accumulation of air or fluid in one or both pleural sacs will necessarily tend to disturb respiration, as in pneumothorax, pleurisy, hydrothorax, or hæmothorax. It acts mechanically, and the degree of disorder will depend on the amount of the collection, the rapidity with which it takes place, the previous condition of the lungs, and other circumstances. Pleuritic adhesions and agglutinations also tend to embarrass respiration more or less seriously.

9. *Morbid conditions of the lungs.*—These have been left to the last, and it will be readily understood that all diseases of the lungs tend more or less to produce disorders of breathing. At the same time it must not be forgotten

that these organs may be affected, even somewhat extensively, under certain conditions, without any obvious respiratory disturbance. Pulmonary diseases act in various ways, of which the most important are by affecting the pulmonary circulation and the amount of blood in the lungs; by interfering with the entrance or exit of air through the bronchial tubes; by temporarily disabling or permanently destroying more or less of the pulmonary textures; or by influencing the respiratory act through its forces, and especially through the impairment or loss of the elastic force of the lungs required for expiration.

CLASSIFICATION.—The arrangement of the numerous forms of disordered respiration is by no means an easy matter, and may be founded on different plans. Before giving that which seems to the writer to be a practical arrangement, he would urge the great importance of endeavouring to recognise in every case, by due investigation, what is the real nature of the deviation from normal breathing, and not merely to call it 'dyspnœa,' or 'difficulty of breathing.' Moreover, it must be remembered that there may be more than one form of disordered respiration in the same case.

The disturbance of breathing may be sudden, acute, or chronic; and its several forms may be included under three main divisions, namely:—
**1. Deficient Respiration. 2. Dyspnœa or Difficulty of Breathing. 3. Peculiar Disorders.**

**1. Deficient Respiration.**—This comprehends the following:—

(*a*) *Slow breathing.*—The frequency of the respirations may be notably reduced, without any other obvious disorder. Or this may be associated with marked shallowness of the movements, so that in extreme cases breathing seems to have almost or entirely ceased, and can scarcely be recognised even by the most delicate tests. These deviations are observed in various conditions or diseases affecting the nervous system, such as hysteria, trance, shock or collapse, narcotic poisoning, and some cases of cerebral disease. They are accompanied by impairment or loss of consciousness, real or assumed, and with other varying symptoms. Sometimes the breathing is slow but deep, and may then be sighing, stertorous, or attended with flapping of the cheeks in expiration; this is noticed in apoplectic conditions. These disorders of breathing do not obviously disturb the patient.

(*b*) *Restrained breathing.*—By this is meant that the patient makes a voluntary and conscious effort to restrain or modify the act, because it produces or increases some painful or other morbid sensation. It may be obvious at once to the observer, or may only be revealed when the patient is made to take a deep inspiration. The respirations are often increased in frequency, but may be below the normal. The entire movements may be affected, or only those of either the chest or the abdomen, or even only of one side of the chest. The early stage of pleurisy, peritonitis, and angina pectoris afford examples of diseases causing this disorder of breathing.

(*c*) *Shallow and feeble breathing.*—The most striking feature in some conditions is the extreme feebleness and limitation of the act of respiration. This has already been alluded to, as noticed in some cases of slow breathing, but the frequency is often much above the normal, and the class of cases now under consideration differ essentially from those previously mentioned. The disorder indicates gradual cessation of the respiratory functions and pulmonary action, becoming more and more obvious, and gradually terminating in death. Little or no air is changed, and at last the breathing becomes a mere ineffectual gasp. This form of disturbance is observed in persons slowly dying from various causes; in gradual filling of the air-tubes in fatal cases of bronchitis; and in cases of apoplexy or narcotism. It is often accompanied by rattling or gurgling *râles*, due to the presence of fluid in the air-passages, which become by degrees filled up. It may follow certain forms of dyspnœa.

(*d*) *Ineffectual breathing.*—The derangement thus named can only be recognised by making the patient attempt to draw a full breath. He may then have the sensation of an inability to do this, or to expand the chest properly. What is more important, however, is that this impairment of the respiratory act is often evident on objective examination, when it is seen that in certain conditions the most powerful efforts to breathe produce little or no result, and the movements are obviously more or less ineffectual, either as a whole, unilaterally, or locally. This may arise from various causes, such as paralysis or spasm of the muscles, rigidity of the chest-walls, distension of the lungs in emphysema, pleuritic and other conditions interfering with their expansion, and certain morbid changes in these organs. Ineffectual breathing is frequently associated with some form of dyspnœa.

**2. Dyspnœa or Difficulty of Breathing.**—Without making too marked a distinction between them, and remembering that they may be combined, there are certain forms of disordered breathing, usually characterised as *dyspnœa*, which deserve separate recognition.

(*a*) *Obstructive dyspnœa.*—This signifies that there is some obvious impediment or difficulty presented to the transmission of air through some part of the air-passages in respiration. The nature and severity of the disorder vary with the seat, cause, and degree of obstruction. Thus it may be that a swollen tongue, or enlarged tonsils or other throat-conditions, block up the passage more or less completely, and the patient breathes through the nose, often with obvious difficulty; or if some air passes by the throat, it does so with much noise, especially when the patient is asleep.

The most important form of obstructive dyspnœa, however, is that which is connected with the main air-tube, and it usually attracts immediate attention. It may be associated either with the larynx or the trachea, and in the former case is liable to exacerbations. The gravity of the phenomena vary with the degree of obstruction, but they are more or less of the following kind. The patient is usually conscious of a difficulty in the passage of the air during respiration, referred to some spot, which may become very distressing; the act of breathing is usually more or less laboured, and this may

culminate in a violent effort or struggle to breathe. The frequency of respiration is often below the normal, or at any rate it is but little increased, while the relative length of inspiration and expiration is disturbed. The difficulty may be experienced only during inspiration, or during both divisions of the act of breathing, but is usually most marked in inspiration, though occasionally during expiration. Various noises are produced by the passage of the air through the narrowed part, and with experience these become of great importance as indicating the existence and seat of obstruction. Signs of deficient aëration of the blood are liable to accompany this form of dyspnœa; and in acute or sudden cases, or if the obstruction is very marked, there is danger of actual suffocation or apnœa, which may occur rapidly or even suddenly. Physical examination will indicate that air does not enter properly into the lungs, as evidenced especially by recession of the lower part of the chest, particularly marked in children, in whom this form of dyspnœa is likely to lead to most serious consequences.

The obstruction may be situated lower down in the respiratory tract, either in one of the main bronchial divisions, or in the tubes distributed through the lungs, and then the character of the disorder merges in that of ordinary dyspnœa, except that it is likely to be attended with various noises, and that the physical signs of deficient entrance of air into one or both lungs are evident. When there are objective signs of deficient entrance of air into the lungs, the condition is termed *inspiratory dyspnœa*. This, however, may also depend upon weakness of the chest-walls, and of the inspiratory muscles, as in rickets.

(*b*) *Excessive breathing—Ordinary dyspnœa.*—This is the disorder usually met with in various degrees, and it implies that respiration is carried on in excess. The act may be too frequent, or too powerful, or both, so that more than the ordinary amount of air is changed in a given time. The movements of the chest are more or less free under different circumstances. In severe cases the patient is obviously distressed, and the act of breathing is laboured, and may be noisy. Then the alæ nasi are seen to work; the patient cannot speak except in broken sentences, owing to want of breath; and there may be signs of apnœa. This form of dyspnœa is familiarly illustrated by the effects of undue exercise, such as running. Clinically it is associated in different degrees with numerous conditions, such as nervous disorders; fevers and other blood-diseases; many cardiac affections; conditions interfering with the action of the lungs; and various diseases of these organs, interfering with their functions, especially if acute.

(*c*) *Shortness of breath.*—While associated with other forms of dyspnœa, this disorder frequently exists alone in various degrees, and it may be of much consequence in drawing attention to disease of a serious character. Shortness of breath signifies that the breathing becomes more or less hurried, and the individual becomes conscious of dyspnœa, after making some effort, which ordinarily does not cause any such effects, such as walking rather quickly or upstairs, singing, coughing, or even taking a few deep breaths in physical examination of the chest. When at rest he may feel perfectly comfortable, and breathing is quite natural, but it is easily disturbed in the manner above indicated. This disorder is observed in general debility; very markedly in anæmia; in many cardiac conditions, especially degeneration; in pleurisy frequently; and in many cases of chronic lung-disease, such as phthisis or emphysema.

(*d*) *Expiratory dyspnœa.*—In the form thus designated the difficulty is experienced in expiration, which becomes prolonged and laboured, in some cases extremely so, the extraordinary muscles of expiration being called fully into play. The relative lengths of inspiration, expiration, and the pauses are thus deranged, and inspiration may become very short, even a mere gasp. There is often a sense of discomfort or even distress, and this is liable in certain conditions to be increased by exertion, or after taking food, or in certain postures. Expiratory dyspnœa may be a prominent feature in some cases of obstruction of the air-tubes; but is essentially connected with impairment of the expiratory elastic force of the lungs in cases of emphysema, and of the chest-walls when they are rigid, these two conditions often going together. These conditions are frequently aided materially by blocking-up of the bronchi, as the result of bronchitis; or by spasmodic contraction of these tubes, in connection with asthma.

(*e*) *Orthopnœa.*—This is almost always combined with one or more of the other forms of dyspnœa, and the term indicates that the patient can only breathe at all, or at any rate comfortably, when the body is in a more or less upright posture. In some cases it is sufficient if he is propped up; in others he has to sit bolt upright in bed, or to bend forward; in others still he is obliged to sit up altogether in some kind of chair, or even to stand, this being the only posture in which breathing can be carried on. Cases of cardiac disease, of acute pericardial and pleuritic effusion, of acute pneumonia, of asthma, and of aneurismal or other thoracic tumours, afford illustrations of the causes of this disorder.

(*f*) *Paroxysmal dyspnœa.*—This may be of various kinds, but as its designation implies, it signifies that the dyspnœa comes on mainly or entirely in fits or paroxysms. It is chiefly exemplified by paroxysms of laryngeal dyspnœa; by some cases of cardiac dyspnœa; and, above all, by fits of bronchial asthma. *See* ASTHMA.

3. **Peculiar Disorders.**—It is scarcely practicable to bring these under any definite subdivisions, and it will suffice to notice the very curious and often indescribable disorders of breathing observed in certain nervous cases; the interrupted, jerky, sighing, or yawning respiration which may be present in various conditions; and the peculiar disturbance which has been named *Cheyne-Stokes respiration*. This is rare, but may occur in connection with certain cardiac diseases, especially fatty degeneration; injury to the brain; and cerebral hæmorrhage. It is characterised by the breathing at intervals becoming by degrees more and more rapid and deep up to a certain point; and then subsiding in the same gradual manner, until finally there is

a complete cessation of respiration, with a dead silence, the pause lasting a variable time, and then the same series of phenomena being repeated.

Effects.—Many of the disorders of breathing which have now been considered are not attended with any obvious effects, and are practically of little or no consequence. Moreover, it must be noted that patients may become so accustomed even to marked derangements of the function of respiration, that they are not conscious of any injurious results therefrom. Most individuals under such circumstances, however, are conscious of more or less discomfort or other sensations, referable to some part of the respiratory apparatus. These are very unreliable and vague in their meaning; but there are effects which give important information in many cases, and which depend either upon the want of due aëration of the blood, or upon the interference with the general venous circulation which disorders of breathing so frequently induce. These will vary, not only with the nature of the disorder, but also with its degree, and the rapidity with which it is set up. Thus there may be actual suffocation, sudden or rapid, or a condition approaching more or less that of asphyxia or apnœa (*see* Asphyxia). Or a chronic state of venous congestion and venosity of the blood may be set up, indicated by a tendency to cyanosis, with enlargement of the superficial capillaries; general chilliness and coldness of the extremities; mental apathy or dulness, with headache and other signs of morbid blood-supply to the brain; general languor, laziness, and muscular weakness; dyspeptic disorders; changes in the urine; and other phenomena. In cases where the respiratory functions are chronically affected in children and young persons, in such a way that the blood is never properly aërated, growth and development are markedly impeded. Patients suffering thus may present a peculiarly stunted appearance. The features tend to become permanently thick and coarse; and the ends of the fingers and toes may become clubbed. In certain forms of dyspnœa the fat of the body tends to disappear; while the muscles of respiration may become hypertrophied from excessive use.

Treatment.—The indications to be fulfilled in treating disorders of respiration, and the measures by which these are to be carried out, must obviously present considerable variety in different cases, and it will only be practicable here to offer a few general hints on the subject. In the first place no treatment whatever may be called for in some instances; while in other cases nothing can be of any service. The primary indication should always be to attend to the cause of the disorder, and by curing, removing, or alleviating this, the disturbance may often be got rid of or materially diminished. This may be illustrated by treatment directed to laryngeal obstruction, anæmia, pleuritic pain or effusion, bronchitis, or cardiac derangement. By improving the condition of the blood when anæmia is present, breathing is frequently much improved, even when there is some actual disease to disturb it, such as phthisis or cardiac disease. Attention to the condition of the air inhaled is in some cases of much importance, as regards its purity, temperature, degree of moisture, pressure, and other points. It must be remembered that some forms of dyspnœa actually require an atmosphere which contains an excess of carbonic acid. Great advantage frequently arises from giving proper instructions to patients as regards posture, avoidance of exertion, diet, the act of coughing, or even the act of breathing itself. This is especially important in certain forms of paroxysmal dyspnœa; and any cause which is known to produce any such attack should be carefully avoided. Moreover, the patient may sometimes be materially assisted in the act of breathing by mechanical means. Not uncommonly active measures are called for, for the purpose of relieving some more or less urgent form of dyspnœa. For this purpose various means are indicated in different cases, such as venesection, or local removal of blood from the chest; dry-cupping over the chest; the internal administration of antispasmodics, stimulants, pulmonary sedatives, or other appropriate agents; inhalations of different kinds, in the form of gas, vapour, or smoke; subcutaneous injections of morphia or other active drugs; or the application to the chest of sinapisms, hot poultices, fomentations, or turpentine stupes. Treatment may be urgently demanded, directed to the asphyxial condition (*see* Asphyxia); and operative procedures, such as laryngotomy or tracheotomy, may be called for. In chronic cases, where the respiratory functions are imperfectly carried on, the conditions resulting therefrom must be remembered, and as far as possible obviated. Warm clothing is essential under such circumstances; and, if practicable, a residence in a genial and warm climate is often of the greatest consequence.

Frederick T. Roberts.

**RESPIRATORY MURMUR.**—The sound heard on auscultation over the lungs in respiration. *See* Physical Examination.

**RESPIRATORY ORGANS, Diseases of.** The diseases which must be referred to in this article are those involving the special organs by which the function of respiration is performed. These organs comprise, first, the lungs, in which the process of respiration takes place; secondly, those organs through which the air is brought into contact with the blood, that is, the air-passages, and the agencies by which the movement of the air is effected; and thirdly, indirectly, those organs by which the blood is brought into contact with the air, that is, the heart and blood-vessels.

Frequency and Fatality.—General Ætiology.—Before enumerating the several morbid conditions of the respiratory organs, it will be well to indicate the importance of this class of diseases—an importance which is due partly to the remarkable frequency with which they occur, and partly to the great fatality by which they are attended.

On reference to the returns of the Registrar-General (*Annual Report* for 1880), we find his calculations showing that whilst during 25 years (1850–74) 5038·7 per million of persons living died of zymotic diseases, no fewer than 5840 died of diseases of the respiratory organs (in-

cluding phthisis, and excluding the organs of circulation). This report further shows that the two great classes of diseases, the zymotic and respiratory, together accounted for almost one-half of all the deaths from every cause, including accidents. It must be remembered, further, that these figures represent only the number of *deaths* from respiratory diseases, and give but a rough indication of the number of instances of illness more or less grave from the same causes.

When we come to investigate more closely the nature of these diseases, it is not difficult to account for the frequency of their occurrence. Complicated, delicate, and sensitive as the respiratory organs are in structure and function, including the pulmonary circulation, and the very important changes in the blood which occur in the capillaries of the lungs; controlled by the nervous system, itself subject to a great variety of influences of a morbific character; dependent for the performance of the healthy act of respiration upon the continual movement of the mechanism which admits air to the lungs, namely, the chest-walls and the respiratory passages; affected also by the temperature of the air subject as it is to great variety, by its purity, liable as this is to be contaminated by noxious gases and impure particles, as well as to be damaged in its quality by alterations as regards dryness and moisture—it is easy to understand how the respiratory organs should become so frequently the seat of disease. Besides the more important influences to which we have referred, it will suffice to mention the effect that is exerted by such factors as occupation, age, sex, and climate. These several ætiological points will be found fully discussed in the articles Climate; and Disease, Causes of. The influences of inheritance and diathesis also contribute powerfully to the causation of disease of the respiratory organs, more especially as predisposing elements in the production of phthisis, although the influence of both can be traced in certain other morbid states, such as bronchitis, asthma, &c.

General Pathology.—The respiratory organs are liable to the several forms of injury and of disease which affect the other organs and tissues of the body. The injuries, including wounds and the presence of foreign bodies, are chiefly of surgical interest. The chief diseases are:—1, disturbances of circulation, including inflammation and its effects; 2, degenerations; 3, new growths; 4, malformations and malpositions; 5, deformities; and 6, nervo-muscular disorders.

1. Disturbances of the circulation are found more especially in the mucous membrane of the air-passages, in the substance of the lungs, and in the serous coverings of these organs. Thus we have—as instances of inflammation, specific or otherwise—laryngitis and tracheitis (including croup and diphtheria); bronchitis, in its several and varied forms; pneumonia, and pleurisy; ulceration, which may occur in any part of the tract; and gangrene, especially of the lungs. Congestion more generally affects the lung-substance, but it is also to be met with in the mucous membranes of the passages. Hæmorrhage may occur from any portion of the air-passages, or from the substance of the lung itself, as the result of congestion, of tubercular disease and its effects, of disease of the heart and blood vessels, and other causes. Examples of thrombosis and embolism may be found in the pulmonary artery and veins.

2. Examples of degenerative disease are presented by the indurations which the cartilaginous tissues of the larynx, trachea, and chest-walls undergo; in the degeneration which is traceable in the air-cells in connection with emphysema; the pigmentary and calcareous changes found in the bronchial glands and lung-tissue; and the caseous degeneration of inflammatory and new growths, such as tubercle.

3. The most important of the new growths are tubercle; malignant disease in its several forms, whether primary or secondary, extending from surrounding parts; syphilis in its various stages, more especially affecting the larynx; and hydatids.

4. Malformations and malpositions of the lungs and air-passages are of rare occurrence, and are of most importance when portions of the lungs are undeveloped, as in atelectasis.

5. Deformities implicate most frequently the walls of the chest.

6. Lastly, there are the various nervo-muscular affections comprehended under the names of whooping cough, nervous aphonia, spasmodic cough, laryngismus stridulus, hiccup, spasmodic dyspnœa including asthma, paralysis of the laryngeal muscles, of the walls of the chest, or of the diaphragm; also pleurodynia and intercostal neuralgia.

Although we have thus spoken of the several portions of the respiratory organs, and the diseases which affect them, as having, so to say, separate relations, we find no such isolation existing in the natural history of their diseases. Thus, for example, we seldom find inflammation of the lung in the absence of an affection of the pleura; whilst when the like process affects the air-passages, it is rarely limited to one part, such as the larynx, trachea, or bronchi, without involving others, and it frequently passes on into the substance of the lung itself. Again one morbid process may be, and is very frequently, associated with others; thus inflammation may lead to degeneration of tissue, or *vice versâ*; new growths may give rise to obstruction of breathing, to inflammation, and frequently to hæmorrhage; and nervo-muscular affections may be either the cause or the effect of similar disorder or disease. Here, too, we have to observe the relation between heart-disease and disease of the lungs; likewise between morbid states of these organs and diseases of the abdominal organs.

General Symptomatology.—The special symptoms of disease of the respiratory organs are founded essentially on disturbances which prominently affect their functions. Thus we have:—1. disorders of the respiration, as fully discussed in the preceding article. 2. There are also obstructions and consequent disturbances of the circulation, which cause (*a*) congestion of the superficial or deep-seated organs, including the heart itself, the cavities of which may become dilated; and (*b*) hæmorrhages, especially hæmoptysis. 3. There occur disorders of secretions and morbid products, giving rise to varieties

of expectoration of more or less importance, as symptomatic of different forms of disease (*see* Expectoration). 4. Cough is a symptom seldom absent, presenting many varieties. It is sometimes entirely referable to nervous disturbance, and of a reflex character; whilst at other times it is the means by which secretions are expelled, which might otherwise accumulate, and lead to further embarrassment and distress (*see* Cough). The diseases of the respiratory organs are often attended by local and constitutional disturbance, as are diseases of other organs, such as pain, fever, wasting, and general debility, which will vary according to the nature of the morbid process and the part involved, as will be found fully described under special headings.

Physical Signs.—The function of respiration is so intimately associated with physical conditions and mechanical actions, that the respiratory organs afford special materials for the application of the principles of physical diagnosis. The movements of air and the resonance of the voice through the several classes of air-passages, and into the minute textures of the lungs, cause characteristic sounds which are readily recognisable by the ear. These sounds become modified by the presence of disease, and afford characteristic evidence, by which its existence and nature may be determined. The size, the shape, and the movements of the chest-walls afford also available evidence in physical diagnosis. Valuable information is afforded by a part that is resonant becoming dull, or by a part which should be dull becoming resonant. For further information on these points *see* Physical Examination.

Treatment.—The diseases of the respiratory organs must be treated, whether for prevention or for cure, on those general principles which are applicable to the treatment of the diseases of other viscera; with such modifications as may be called for by the special structure and function of the organs themselves, and by any special features which disease affecting them may present. These general principles, and their particular applications, are so fully set forth in the articles which treat of the several diseases of the different parts of the respiratory system, that it is not necessary to discuss them again here.

But seeing the extreme frequency with which disease of these organs occurs, and its grave results, affecting alike the young and the aged, those who labour and those who pursue only pleasure, those who live in cabins and those who live in castles—for *æquo pulsat pede pauperum tabernas regumque turres*—we may enter a little more fully on the subject of their prevention.

*Preventive Treatment.*—The principles which must guide us in this direction, independently of those which fall under the head of general hygiene, fully treated of in other articles, are:—

1. That a supply of *uncontaminated air* is essential for the prevention of lung-disease. Impure air is found in the homes of the poor, and in their close and crowded workshops; but it also abounds in the assembly room, the banqueting hall, and such-like places. The remedy for this evil will be found, when people are made to feel that pure air is as essential to health and life as is unadulterated food; and when those who construct houses are convinced that they have no more essential duty to perform than that of devising means for the removal of impurities, and for the supply of pure air and pure water.

2. Pure air, however, can only be utilized by *freedom of the respiratory movements.* Many employments and trades involve constrained positions, which, no doubt, are often unavoidable; but even in such cases a knowledge of the fact that such positions are hurtful, with a desire to remedy the evil, will frequently suggest means for its mitigation. Like results follow a very different source of restriction on the movements of the chest, namely, the use of stays and other articles of dress, which not only compress the chest-walls and prevent their free movements, but even displace the contained organs. Much harm may also result from a practice which is called 'setting up' or drill in the army. The recruit is required to 'throw back the shoulders,' an act by which the pectoral muscles are made to act as constricting bands. The drill sergeant aims at expanding and throwing forward the chest-wall, which he does not effect by merely throwing back the shoulders. This object can only be accomplished by teaching the person drilled to take a deep inspiration, and to carry the chest-walls forward. The frequency with which diseases of the lungs, and of the organs of circulation within the chest, occur in the army is a recognised fact, which may in some degree be explained by this objectionable system of drill.

3. In the prevention of chest-disease it is necessary to guard against *vicissitudes of atmosphere and temperature.* This fact is more readily admitted than its teachings are adopted. Most persons cannot entirely avoid exposure to these vicissitudes, but even in such cases counteracting influences are often practicable, and should always be employed. Again, there are those who, not always from necessity, having respired heated air, perhaps for hours, suddenly expose the delicate respiratory mucous membrane to cold air, or the heated surface of the body to a chilling draught. Disease thus originated is within the knowledge of all of us, and all know that such results might have been obviated by forethought. Lastly, there is the necessity for protecting the organs within the chest by suitable covering. Suitable, for example, as is the dress worn by ladies during the day, the dress or rather the undress of many in the evening, would seem almost designed to leave uncovered and unprotected, both front and back, as much as possible of the space which contains the lungs. Many instances of grave disease have thus originated. The remedy is not far to seek, in resisting the objectionable rules of fashion.

If more attention were given to obtain pure air for respiration, and to secure freer action of the respiratory organs, and if more precautions were practised in guarding against the effects of atmospheric changes, it is but a truism—which will not lose in force by being repeated here—to say that diseases of the respiratory organs would be infinitely less frequent in their occurrence than they are, and less serious in their results.

Finally, if these remarks apply, as they do, to the strong and healthy, it is unnecessary to urge the absolute necessity of insisting upon the prac-

tical suggestions which they convey in the case of persons whose respiratory organs are either constitutionally delicate by inheritance, or have been previously weakened by disease. Such are the chief victims of chronic lung-disease; and in no class of disease is prevention so absolutely essential. R. QUAIN, M.D.

**REST, Therapeutics of.**—In considering rest as a therapeutic agent it is requisite to understand its nature, the indications for its use, its varieties, and the ways of employing it. There are three chief varieties:—1, Rest of the *whole body* by sleep; 2, rest of the *mind*; and 3, local rest of a *diseased organ* or *inflamed part*. Of any of these, but of the third in particular, the practitioner may directly avail himself in the treatment of disease. The *modus operandi* of these varieties of rest consists in allowing the impaired, perverted, or lost functions of a part, or of the whole of the human frame, to be reinstated by maintaining the equilibrium of demand and supply. Hence it is only by availing oneself of the *physiological* properties of the component parts of the body, that rest becomes a therapeutic agent; and it must be borne in mind that *physiological* rest does not mean another variety, but rather that it regulates the employment of one or more of these varieties; and that whether applied to the whole frame, to the mind, or to a localised part, it is the agent, in the guiding hands of the practitioner, which cures.

1. *Rest of the whole body and mind: repose in sleep.*—This form of rest, which is so necessary to the well-being and the due performance of the several functions of the human body, accomplishes two ends:—First, the arrest of further waste of nerve-force and tissue-metamorphosis—a checking or 'diminution of chemical action' (B. Jones); and, secondly, the repair of the used-up materials. Rest of sleep, in a healthy man, does not of itself restore energy to the weary limbs, or vigour to the exhausted frame—it does but place the patient in the best possible condition for nature's recuperative powers to exercise their sway without detraction or interruption. Sleep may be looked upon as both a preventive of disease, and a curative means. The want of sleep and its attendant physiological processes of repair to the growing tissues of an infant—arising from whatever cause it may, such as teething, vesical calculus, flatulence, or worms—becomes of itself a direct cause of arrest of development and of wasting diseases, and lays the seeds of future misery and early death. A healthy adult can for a time, with impunity, do without much sleep; but let it never be forgotten not only that the want of it acts as a great predisponent to the infection of fever and all contagious diseases, and, in fever, to diseases of the brain; but also that in any disease, if carried too far, it becomes a cause of death.

2. *Rest of the mind: relaxation.*—The light story, the strains of music, the change of scene and society, are familiar to all as among the many ways by which rest is given to the overworked brain and careworn mind.

The waste of nerve-force attendant on long and deep thought, and the many strains put upon the brain in these days of emulation and hurry, must be repaired, in like manner as muscular waste, by sleep and cessation from all mental work for a time. In too many cases has it happened that insomnia, the first indication of the disturbance of that equilibrium of the mental state comprehended in the term 'sanity,' has ended, before long, within the portals of an asylum, in epilepsy, insanity, or idiocy.

Hence, 'in all diseases,' writes Hilton, 'of no matter what nature, of the cerebro-spinal system, when the evidence of disease is in deranged function, it becomes our duty to look upon and treat the altered nerve-substance as we do contusion and laceration of soft parts and congestion of organs, and to give the brain absolute rest, to rely on nature's power to repair the injury or disturbance, and to avoid stimulants which excite rapid circulation, as much as possible. The brain disturbed in its vital endowment becomes unequal to even its ordinary duties. It recovers itself slowly; it then soon becomes fatigued from use; and if claims are made upon it too soon after injury—that is, before structural and physiological integrity is re-acquired—the patient is very likely to suffer from serious disease of the brain. The brain requires absence from occupation, or rest, for its complete recovery, and this should be in proportion to the severity and duration of the symptoms it presents; in fact, the length of time which has been required by nature for the repair of the injury must be in proportion to the severity of the local injury; and the more severe the injury the longer the time required for perfect recovery of the functions of the brain. If this principle were only adopted generally and the plan carried out, we should not witness so many chronic diseases of the brain.' *See* PERSONAL HEALTH.

3. *Local rest.*—This, which may be called *mechanical rest*, is well known to every surgeon to be an agent of supreme value in the treatment of wounds, fractures, displacements or inflammation of joints; as it is obvious that every movement to which a wounded or inflamed part is subjected must act on the one hand like the repetition of the original injury, and upon the other like a continuance of the irritating cause. Thus rest is not only a negative advantage, as saving the patient from renewed injury or irritation, but a positive remedy, as it diminishes the heat of the body, reduces the pulse, and alleviates pain. Rest is of so much value in the treatment of inflammation, that in some instances no means will advance the cure without it, and numerous injuries of the body, externally or internally, would do well with perfect local rest and nothing else.

It was on this principle that Pott treated all fractures of the extremities, by relaxing the muscles which had been thrown into spasm by the fracture; and it is this principle that nature would teach, when we see, in hip-joint disease, immobility of the inflamed parts maintained by the vital anchylosis of the capsular muscles; when we notice the recti abdominis become hard and rigid in hepatic abscess or peritonitis; and when we find the fractured ends of a rib held together in a cylinder of ensheathing callus.

To a physician mechanical rest is an invaluable agent, and yet its benefits are not recognised in a practical way at all as frequently or as fully as they should be.

Application.—The application of rest in diseased conditions of the different parts of the body is so varied, and the cases in which it should be employed are so numerous, that it would be impossible to enumerate them all. In surgical practice rest is constantly used in the treatment of injuries and diseases. Here we shall only deal with its employment in medical practice, and shall select a few examples, to illustrate its benefit in different regions of the body.

*A.* **Diseases of the respiratory organs.** The objects of the treatment by rest may be stated to be (Roberts):—1. To maintain structures, which are actually diseased, or in danger of becoming so, in as quiescent a state as possible; in short to try to produce mechanical rest, as is ordinarily done in the case of a diseased joint. 2. To check or limit the entrance of irritating gases—be they noxious, or simply of a different degree of temperature or humidity from that of the internal part with which the air comes in contact. 3. To quiet the circulation through the organs, which are being placed in a condition suitable for repair.

1. *Acute inflammation of the larynx and bronchi.*—The patient is to be placed in an equable and moderately high temperature, and the atmosphere impregnated with moisture; all speaking or using the voice must be forbidden, while the patient's wants may be made known by means of a slate and pencil (Hilton). Thus, not only is the breathing quieter and less frequent, but all irritation of cold and of dry air prevented.

2. *Acute capillary bronchitis.*—In this disease, while general rest is to be maintained, the indications to relieve the congested right heart, and to remove the mucus which is causing the symptoms of asphyxia, predominate; and physiological rest cannot in this instance be obtained by mechanical rest. Here relief is attainable by restraining with the one hand the outpouring of mucus into the small tubes of the lung, and getting rid of that which is already poured out, by means of alkalies and stimulating expectorants; and by maintaining, with the other hand, the forces of the circulation, and relieving the overloaded right heart, by hydragogue cathartics, diuretics, and diaphoretics.

3. *Pleurisy.*—In addition to keeping the patient quiet, restraining breathing, and forbidding conversation, the most effectual way of employing rest to the inflamed surfaces of the serous membrane, is by mechanically fixing the side with adhesive plaster, as we would do for an inflamed joint. The forms of pleuritis to which this is most applicable are:—Acute general pleurisy, seen early; dry pleurisy of a small area; that accompanying pneumonia, the result of a fractured rib; and in the advanced stages of phthisis pulmonalis, where fits of coughing and pain are produced by stretching of those bands of organised lymph which bind the costal and visceral layers together. It is also applicable in external fistula, and in pleurodynia. The plan proposed by Dr. Roberts, and which has answered remarkably well in the hands of the writer, is as follows:—Apply two or three layers of plaster, cut in strips of about four inches, thus: the first strip is laid on obliquely in the direction of the ribs, the second across the course of the ribs, the third in the direction of the first, the fourth as the second, and so on until the entire side is covered. A strip is also passed over the shoulder, which is kept down by another fixed round the side across its ends. Each strip should be long enough to extend from the spine to the sternum.

4. *Phthisis pulmonalis.*—The stage at which mechanical rest becomes a decided therapeutic is that of breaking-down of the lung-tissue, and the formation of large cavities. Its application at an earlier stage is also useful in relieving the distress of breathing; but it seems most suitable as a means of checking the short hacking cough, and the stitch-like pains, produced by stretching of those parts of the lungs which have been united by adhesive inflammation to the costal layers of the pleura. By means of strapping the upper part of the chest, corresponding to the disease, with diachylon spread on leather, and filling all the hollows previously with cotton-wool, so as to prevent all motion on inspiration or expiration, rest and quiet is obtained, and not only is cicatrisation encouraged, should such have commenced, but the risk of either hæmorrhage by rupture of an artery, or the laceration of the pleura pulmonalis and consequent pneumothorax, is averted.

*B.* **Diseases of the heart and blood-vessels.**—1. *Pericarditis.* The mode of applying rest in this disease must necessarily be different from that which obtains in pleurisy, as actual arrest or even limitation, to any degree, of the heart's action—which theoretically and by analogy might be expected to be followed by the best results—would of course be out of the question. Rest must therefore be differently attained, by general rest and quiet, and by physiological medication. The advantages of perfect rest in the horizontal position, are evident, as by it the attrition of the inflamed surfaces against each other is lessened by some 17,280 beats in the twenty-four hours, and thereby the tendency to effusion diminished, and resolution encouraged. The medicine above all others to produce physiological quiet is opium. When not otherwise contra-indicated, and when carefully watched, it is to be used freely, in grain doses every second or third hour, as it is remarkably little liable to produce narcotism.

2. *Internal aneurism.*—For a long time, until recent years, this disease was looked upon as beyond the reach of medicines or cure. Valsalva saw the clue to treatment, and attempted to induce rest, and such a state of the general circulation that the aneurismal sac might be filled by the fibrin of the blood; but the means he adopted were not physiologically correct, and to Mr. Tufnell, of Dublin, is due the credit of having so modified the treatment as to obtain that rest which alone can cure the aneurism. Mr. Tufnell's method may shortly be stated to be as follows:—The patient is to be placed in a bright airy room on a prepared bed or couch, on which he must be contented to remain for eight or ten weeks. He must thus lie in the horizontal position, and not even for a moment assume the erect posture. Accordingly the bed must be so constructed that the requirements of nature can be attended to without alteration of position. The diet is to be restricted to a minimum of solids and fluids. The patient's mind is to be freed from

all anxiety, and pain and sleeplessness relieved by opium. The object of these means is to give rest to the aneurism (1) by reducing the absolute quantity of blood circulating, without taking any of its ingredients from it by bleeding; (2) by rendering the blood hyperinotic; (3) by diminishing the rate and force of the current through the sac. The horizontal position in a healthy individual makes a difference of at least twelve cardiac beats a minute less than in the erect position, and in disease this difference amounts to twenty or even forty beats. Taking it at the lowest rate of difference it is evident that in the horizontal position the blood circulates 17,280 times less through the body in the twenty-four hours. The aneurismal sac is proportionately less often distended, and the threatened breach in the wall of the artery is averted by layers of fibrin deposited by the more slowly moving and concentrated stream.

*C.* **Diseases of the abdominal viscera.**—In the therapeutic consideration of disease of these organs the principle of rest is not less plainly indicated than in the other parts of the body we have discussed; and by neglect of so simple and yet so potent an agent all other treatment may signally fail to relieve or to cure.

1. *Diseases of the stomach and intestines.*—The whole basis of treatment often depends upon strict diet, and in some cases temporary total deprivation of food, enemata supplying the requisite nourishment. Local rest can best be obtained by the physiological action of opium upon the vermicular movements of the intestines, and by avoiding all irritants or purgatives. Opium may be required in full doses, so as to arrest all peristalsis; and thus an inflamed or ulcerated surface is placed at rest, and nature is enabled to prevent perforation, and cure the disease. It cannot be too strongly stated that the injudicious employment of purgatives in threatened perforation is not only unscientific, but the worst possible practice, as it is almost sure to result in the death of the patient. This line of treatment by rest holds good in simple or cancerous gastric ulcer, Curling's ulcer, typhoid ulceration, and that due to foreign bodies in the appendix vermiformis. The practitioner will find it also his best guide and indispensable aid to cure in perityphlitis, hepatic abscess, ileus, after operations for hernia, and in various other conditions.

2. *Inflammation of the kidneys.*—As the skin and bowels may vicariously perform many of the excretory functions of the kidney, the first indication in acute nephritis is to relieve and rest that organ, by general rest, local depletion, and by calling vigorously upon the skin and intestines. In some cases where the equilibrium of secretion and excretion is thrown much out of balance, and where convulsions and dropsy point to an hydræmic and toxæmic state, we should use venesection as the readiest and most efficient means of attaining our object, of curing by rest.

Conclusion.—The foregoing illustrations show the benefit of rest in its varied aspects, not as a remedy to the exclusion of others, but as a therapeutic agent by which nature is reinstated on the throne, so that she may again exercise her vital powers to restore order, give health, and maintain life.

J. Mager Finny.



**RESTLESSNESS.**—This signifies a condition of constant movement; the movements being random and non-purposive, or only semi-purposive and fitful in character. The condition itself may be due to the most various causes. Thus it may be met with in children who are the subjects of connate mental defects, and who are scarcely ever at rest during their waking hours; or it may be seen for a time, and especially in 'nervous' people under conditions of extreme mental excitement. In various forms of delirium, or of mania, either subacute or acute, restlessness also exists to a well-marked degree. Where it occurs in fevers to a notable extent it usually co-exists with delirium. Restlessness is likewise a prominent feature in patients who are suffering from severe and abiding pain in almost any part of the body; or in those who have suddenly lost large quantities of blood, either from the uterus or elsewhere. *See* Jactitation.

Treatment.—This being a mere symptom, dependent upon very many totally different underlying conditions, its treatment in each particular case resolves itself into the treatment of the general condition upon which the symptom is dependent.

H. Charlton Bastian.

**RESUSCITATION** (*re-*, again, and *suscito*, I stir up).—Definition.—The recovery from suspended animation or apparent death. In these conditions, of course, all signs of circulation and respiration have disappeared, but usually the failure of one function has preceded the other. For the purposes of treatment we may regard as (A.) *syncope* those cases where the lips and mucous membrane are found pale and exsanguine; and as (B.) *asphyxia* those where they are dark-coloured.

A. *Syncope.*—Syncope may arise (1) from mental emotion, sudden pain, or shock; (2) from drugs and poisons, including anæsthetics, especially chloroform; (3) from hæmorrhage, or anything which reduces the due supply of blood to the heart; and (4) from fatty degeneration or dilatation of that organ.

Treatment.—Place the patient horizontally on his left side, with the pelvis and feet raised. Nélaton has urged complete inversion of the body, but by its interference with the free action of the diaphragm this method may be injurious. The windows of the room should be opened; the face fanned; and a little cold water may be sprinkled on the forehead. Smelling salts being held to the nostrils, if natural breathing has not returned, begin *Howard's method* of artificial respiration:—*Position of patient.* Face upwards; a hard roll of clothing beneath thorax, with shoulders slightly declining over it. Head and neck bent back to the utmost. Hands on top of head. Strip clothing from waist and neck. *Position of operator.*—Kneel astride patient's hips; place your hands upon his chest, so that the ball of each thumb and little finger rest upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers dipping into the corresponding intercostal spaces. Fix your elbows firmly, making them one with your hips. *Action of operator.*—Pressing upwards and inwards to-

wards the diaphragm, use your knees as a pivot, and throw your weight slowly forwards two or three seconds, until your face almost touches that of your patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds; then repeat this movement as before, continuing it at the rate of seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural.

This method is said to keep the passage through the larynx free without the aid of an assistant or any contrivance for the purpose, and is recommended for that reason. Artificial respiration must precede the use of the stomach-pump, and be continued until either the pulse or natural respiration returns. Keep up the temperature of the body by hot blankets or hot bottles. Stimulating the heart by galvanism has been recommended, but it is a doubtful remedy. It is not easy to make it produce general and effective contraction, such as would cause the blood to move forward, and, failing to do this, it probably does harm by exhausting the irritability of those parts which it does excite. Ether, or nitrite of amyl, may be held to the nostrils. A little brandy and hot water, eau de cologne and water, wine, or other stimulant, as sulphuric ether or sal volatile, is now to be given, with care that none of it enters the trachea. If swallowing is impracticable, inject warm fluids into the rectum. In cases of syncope from loss of blood transfusion may be required. *See* TRANSFUSION.

B. *Asphyxia.* (a) *Asphyxia Neonatorum.*—The mouth and nostrils of the infant should be wiped dry; and the body freely exposed, whilst the head is allowed to fall back over the hand which supports the nape. A few drops of cold water may be sprinkled upon the chest, and the face should be fanned or blown upon for one minute only. Next inflate the lungs by blowing into the nose and mouth; and then squeeze the trunk. The body should now be immersed in water at 100°, from which the chest should be raised every half-minute and sprinkled with cold water. Sylvester's method of artificial respiration is the best. Marshall Hall's and Howard's methods may be used after the first inspiration has occurred, or together with mouth-to-mouth insufflation (*see* ARTIFICIAL RESPIRATION). Experiments made by Dr. Champneys show that Hall and Howard's methods of artificial respiration are absolutely useless as a means of directly inflating the lungs of still-born children; and also that Sylvester's method, and its modification by Bain and Pacini, introduce more air than any other method.

(b) *Asphyxia from breathing noxious gases.* The body should be brought into fresh air; artificial respiration be at once commenced; whilst an assistant should blow into the nostrils three or four times; and hot blankets and hot water bottles be applied.

(c) *Asphyxia from mechanical obstruction of the air-passages.*—The cause of obstruction must be removed, if possible, by adopting the inverted position of Howard's method. Coins or plum-stones may thus dislodge themselves. In the absence of forceps, a button-hook or the handle of a tablespoon may be useful, especially in the removal of a lump of hard food. Laryngotomy or tracheotomy must be performed the instant the pulse becomes imperceptible at the wrist.

(d) *Asphyxia from poisons or anæsthetics.*—In the asphyxia of advancing coma from narcotics and anæsthetics, the breathing may stop from failure of the medulla and respiratory tract. In this case artificial respiration, by simply compressing the chest at intervals of five seconds, may suffice, but very often there is the mechanical obstruction in the larynx to be considered. If raising the chin and throwing the head back do not effect a free passage of air, Howard's or some other method of artificial respiration should be commenced (*see* ARTIFICIAL RESPIRATION). It is well to understand that when the muscles of the larynx are paralysed, the glottis becomes valvular in action or partially so—that is to say, it permits air to pass outward freely, but only a weak current of air to pass inward. A strong current brings the sides together and gives rise to complete obstruction. This is chiefly caused by the drawing together of the relaxed arytæno-epiglottidean folds of mucous membrane; and in order to obviate this kind of obstruction, the folds should be tightened, by throwing back the head and raising the chin as far as possible away from the sternum. This will render it unnecessary to catch hold of the tongue with artery forceps, the treatment usually recommended.

(e) *Asphyxia from drowning.*—In asphyxia from immersion in water there are two serious complications, namely, first, the presence of water and mud in the air-passages, and, secondly, the depressing effect of cold. With the view of more effectually removing the water from the air-tubes Howard gives the following rules:—*Position of patient.* Face downwards. A hard roll of clothing beneath the epigastrium, making that the highest point, the mouth the lowest. Forehead resting on forearm or wrist, keeping mouth from ground. *Position and action of operator.* Place left hand, well-spread, upon the base of the thorax to the left of the spine; the right hand upon the spine, a little below the left and over the lower part of the stomach. Throw upon them, with a forward motion, all the weight and force the age and sex of the patient will justify, ending this pressure of two or three seconds by a sharp push, which helps you back again into the upright position. Repeat this two or three times, according to the duration of the emersion, and then resort to the method described in the treatment of syncope

The following rules have been published by the Royal Humane Society. They recommend the Sylvester method, but probably this and the modification by Bain, in which the anterior fold of the axilla on both sides is grasped with the clavicle and pulled upwards, are less useful than the Howard plan, which favours the patency of the air-passages.

**Directions for Restoring the Apparently Dead.**

I.—If from DROWNING OR OTHER SUFFOCATION, OR NARCOTIC POISONING.—Send immediately for medical assistance, blankets and dry

clothing, but proceed to treat the patient INSTANTLY, securing as much fresh air as possible.

The points to be aimed at are—first, and immediately, the RESTORATION OF BREATHING; and, secondly, after breathing is restored, the PROMOTION OF WARMTH AND CIRCULATION.

The efforts to restore life must be persevered in until the arrival of medical assistance, or until the pulse and breathing have ceased for at least an hour.

**Treatment to Restore Natural Breathing.**

Rule 1.—*To maintain a free entrance of air into the windpipe.*—Cleanse the mouth and nostrils; open the mouth; draw forward the patient's tongue, and keep it forward: an elastic band over the tongue and under the chin will answer this purpose. Remove all tight clothing from about the neck and chest.

Rule 2.—*To adjust the patient's position.*—Place the patient on his back on a flat surface, inclined a little from the feet upwards; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder-blades.

Rule 3.—*To imitate the movements of breathing.*—Grasp the patient's arms just above the elbows, and draw the arms gently and steadily upwards, until they meet above the head (this is for the purpose of drawing air into the lungs); and keep the arms in that position for two seconds. Then turn down the patient's arms, and press them gently and firmly for two seconds against the sides of the chest (this is with the object of pressing air out of the lungs. Pressure on the breast-bone will aid this).

Repeat these measures alternately, deliberately, and perseveringly, fifteen times in a minute, until a spontaneous effort to respire is perceived, immediately upon which cease to imitate the movements of breathing, and proceed to INDUCE CIRCULATION AND WARMTH.

Should a warm bath be procurable, the body may be placed in it up to the neck, continuing to imitate the movements of breathing. Raise the body in twenty seconds in a sitting position, and dash cold water against the chest and face, and pass ammonia under the nose. The patient should not be kept in the warm bath longer than five or six minutes.

Rule 4.—*To excite inspiration.*—During the employment of the above method excite the nostrils with snuff or smelling-salts, or tickle the throat with a feather. Rub the chest and face briskly, and dash cold and hot water alternately on them.

**Treatment after Natural Breathing has been Restored.**

Rule 5.—*To induce circulation and warmth.* Wrap the patient in dry blankets, and commence rubbing the limbs upwards firmly and energetically. Promote the warmth of the body by the application of hot flannels, bottles, or bladders of hot water, hot bricks, &c., to the pit of the stomach, armpits, between the thighs, and at the soles of the feet. Warm clothing may generally be had from the bystanders. When swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee should be given. Sleep should be encouraged. During reaction large mustard poultices to the chest will relieve the distressed breathing.

II.—If from INTENSE COLD.—Rub the body with snow, ice, or cold water. Restore warmth by slow degrees. It is dangerous to apply heat too early.

III.—If from INTOXICATION.—Lay the individual on his side on a bed with his head raised. The patient should be induced to vomit.

IV.—If from APOPLEXY or SUNSTROKE.—Cold should be applied to the head, which should be kept raised. Tight clothing should be removed, and stimulants cautiously used.

How soon should alcoholic stimulants be given? Certainly not until natural respiration has been induced, and in cases of narcotic poisoning, not until consciousness has been restored. If, on the return of consciousness, the patient is in pain or faint, the inhalation of a few drops of ether or smelling ammonia is indicated. In their absence a few teaspoonfuls of brandy may be given. Hot tea and coffee should be the first refreshment swallowed, and in general it should not be pressed upon the patient, as vomiting is more exhausting than waiting a few hours for food. J. T. CLOVER.

**RETCHING** (A.-Saxon, *hrœcan*).—An ineffectual effort at vomiting, sometimes accompanied by the expulsion of gas from the stomach. *See* VOMITING.

**RETENTION** (*re-*, back, and *teneo*, I hold). This word is employed in medical science to imply that some material, whether solid or liquid, which ought to be discharged, is retained or kept back in a cavity or canal, either natural or artificial. Thus we speak of *retention of urine*, *fæces*, *menses*, and *bile*; and also of *pus* under certain circumstances.

**RETENTION OF URINE.**—*See* MICTURITION, Disorders of.

**RETINITIS.**—Inflammation of the retina. *See* EYE AND ITS APPENDAGES, Diseases of.

**RETRACTED ABDOMEN.**—The abdomen as a whole presents under certain circumstances more or less depression of its anterior wall, when it is said to be *retracted*, and this may reach such a degree that the abdomen becomes boat-shaped, and its anterior boundary sometimes seems almost to come into contact with the spinal column behind. The bony prominences of the crest and anterior angles of the ilium, the pubes, Poupart's ligament, and the lower margin of the chest often stand out prominently. In some instances the retraction is partial, involving the lower part of the abdomen, while the upper part is enlarged.

A retracted abdomen frequently renders it more easy to investigate by physical examination the contents of this cavity; and it must be remembered that the condition may be associated with diseases of abdominal organs which can thus be readily detected, or with abdominal tumours. It may, however, also itself give information of importance in diagnosis. The chief conditions under which a retracted abdomen may be met with, so as to be of clinical importance, are

as follows:—1. In certain cases of disease of the brain or its membranes, and especially acute meningitis. 2. In some forms of intestinal colic, particularly that form associated with lead-poisoning—the so-called *painter's colic*. 3. As a part of marked general emaciation from any cause, but especially that due to starvation, or to chronic diarrhœa from intestinal ulceration and other conditions. 4. In connection with chronic diseases of the œsophagus, stomach, intestine, or pancreas, causing obstruction in some part of the alimentary canal, so that food cannot be taken in, or is prevented from passing along. Here the retraction is also partly due to the general emaciation. 5. As one of the consequences of chronic peritonitis. It will be seen, from a consideration of the causes just mentioned, that retraction of the abdomen immediately results either from a spasmodic contraction of the intestines and abdominal muscles; general wasting; absence of food from, and contraction of the alimentary canal; or peritoneal adhesions. It may be mentioned that marked temporary retraction of the abdomen is sometimes noticed in connection with the act of breathing, in consequence of disordered action of the diaphragm.

FREDERICK T. ROBERTS.

**RETRACTED CHEST.** *See* DEFORMITIES OF THE CHEST.

**RETROCEDENT** (*retro*, back, and *cedo*, I depart).—A term employed in connection with certain acute diseases, when their prominent external manifestations disappear or, as it were, go back. Retrocession is often associated with the simultaneous occurrence of internal disturbance. The phenomenon is observed in gout, rheumatism, certain skin-diseases, and the eruptive fevers.

**RETROFLEXION** (*retro*, back, and *flecto*, I bend).—A form of displacement in which an organ is bent backwards upon itself. *See* WOMB, Diseases of.

**RETRO-PHARYNGEAL ABSCESS.**—SYNON.: Post-pharyngeal abscess; Fr. *Abcès retro-pharyngien*; Ger. *Retropharyngeal Abscess.*

DEFINITION.—A collection of pus in the loose areolar tissue which connects the pharynx with the muscles lying upon the vertebral column, namely, the longus colli and the rectus anticus major.

ÆTIOLOGY.—This is a somewhat rare affection, and is more commonly met with in children than in adults, more particularly in those of a strumous diathesis. Idiopathic inflammation of this tissue, though usually assigned as one of the causes of the affection, is not often seen. More frequently the inflammation, and resulting abscess, is a secondary disorder, dependent upon an inflamed condition and suppuration of a post-pharyngeal gland, or caries of some of the cervical vertebræ, or their cartilages. Amongst other causes, pyæmia has been noted; and it has also been observed as a sequela to some of the acute fevers.

SYMPTOMS.—As in all disorders where inflammation plays a part, so here the onset of the disease is marked by increase of temperature and pulse, nausea, general restlessness and malaise, and already some amount of soreness of throat is complained of. The degree of pyrexia and constitutional disturbance will vary with the condition and constitution of the sufferer. Soon this soreness of throat develops into the true characteristic pain on making the attempt to swallow, a symptom which is never wanting, and which goes on gradually, though slowly, augmenting, till almost complete dysphagia is established. Accompanying this, or at least soon after, is observed a peculiar stiffness of the neck, which, coincidently with the difficulty of swallowing, becomes more apparent with the progress of the disease. A certain amount of swelling of the neck may also be observed, specially towards the angles of the lower jaw. Difficulty in breathing is another prominent symptom of the disorder, which, more particularly if the abscess be large, becomes greatly aggravated when the patient assumes the horizontal posture. On first looking at such a child with its embarrassed respiration, its anxious expression, its cyanotic lips and cheeks, one might well be excused for momentarily diagnosing the case as one of croup, were it not that, loud and hurried as are the respirations, they are not of a whistling character. Here also the voice is altered; at first hoarse and indistinct, it assumes what is described as a snuffling tone, or a toneless voice. On inspecting the throat, a round swelling is observed in the posterior wall of the pharynx, occupying the centre of the pharyngeal space, or more to one side, whereby the cavity is greatly diminished in size. The mucous membrane presents a livid colour. On passing the finger over the root of the tongue and beyond the soft palate, this tumour will be felt to be either hard and tense, or soft and somewhat indistinctly fluctuating, according to the stage of the disease. When the tumour attains an extraordinary size it has been seen to project in front of the soft palate. A quantity of mucus usually fills the mouth. All attempts at swallowing are fruitless.

PROGNOSIS.—The prognosis is always doubtful. Most usually well-pronounced cases terminate fatally—invariably so if the disease depends upon caries of the vertebræ.

TREATMENT.—Little can be expected in the way of arresting the disease. Usually it is well-pronounced before the physician is called to see the child, or it is some time before he can be quite sure of his diagnosis. Ice may be freely administered, and is most grateful to the patient. So soon as the presence of an abscess is distinctly established, surgical interference must at once be had recourse to, and the abscess laid open by a well-guarded bistoury. Sustaining treatment is urgently demanded.

CLAUD MUIRHEAD.

**RETROVERSION** (*retro*, back, and *verto*, I turn).—A form of displacement in which an organ is turned back. *See* WOMB, Diseases of.

**RE-VACCINATION.**—The operation of repeated vaccination. *See* VACCINATION.

**REVULSENTS** (*revello*, I draw away).—This term dates from the time of the humoral pathology, and signifies therapeutical measures which draw the humours from the part affected.

Any detailed consideration of such supposed effects could only be interesting from an historical point of view. R. Farquharson.

**RHEUMATIC ARTHRITIS.** — Synon.: Rheumatic Gout; Rheumatoid Arthritis; Fr. *Rhumatisme noueux*; *Usure des Cartilages*; Ger. *Arthritis Deformans.*

Definition.—A disease of the joints, the essential nature of which is still unknown; characterised by chronic inflammatory and degenerative changes, involving the various articular structures; and leading to deformity.

Ætiology.—In a considerable proportion of cases, rheumatic arthritis follows ordinary acute rheumatism immediately, or it appears after an interval of several years, during which time chronic rheumatism of a milder degree may have been complained of. Persons of all ages may thus suffer, but the disease generally begins between twenty and forty. It is commonly believed to be more frequent in women, but this is doubtful. Depressing influences of all kinds, including acute diseases, frequent pregnancy, super-lactation, prolonged physical exertion, and mental distress, are unquestionably predisposing factors. The disease is hereditary.

The *exciting* cause is generally chill; but in many instances injury of a joint is the starting point of the morbid process.

Anatomical Characters.—Two well-marked forms of this disease are met with, according as a single joint only, or several—perhaps all—of the joints are affected. In every respect the anatomical characters are identical in the two forms.

Examined at an *early* stage of the morbid process, an affected joint is found to be enlarged; the synovial membrane, capsule, and ligaments being distended and stretched by a considerable amount of effusion. The synovial membrane is hyperæmic, swollen, and thickened; its fimbriæ are enlarged and vascular; intra-articular fibro-cartilages, ligaments, and tendons are vascular and softened; and the articular cartilages are partially removed, leaving a roughened, vascular, porous-like surface behind.

In the more *advanced* stage of the process the effusion is considerably less, or may be completely re-absorbed; and the capsule and ligaments are much thickened, or even partially calcified. The intra-articular structures, including fibro-cartilages, ligaments, tendons, and articular cartilages, have disappeared in a great measure, leaving little or no trace behind. Peculiar pendulous bodies, consisting of masses of fibro-cartilage, are attached to the interior of the synovial membrane; more rarely they are free. The articular cartilages, where their opposed surfaces are in mutual contact, are replaced by an ivory-like layer of bone; whilst at other parts the surfaces present a pink colouration, with small spots of more intense hyperæmia. The articular surfaces are variously altered in shape and size. Thus articular cavities are widened, and occasionally deepened, by enlargement of the circumference, in the form of 'lips,' or by the production of separate bony masses in the same situation: whilst the heads of bones are enlarged; present similar 'lips' or sharp edges at their widened margins; become flattened at right angles to the axis of pressure; and thus preserve their relations with the corresponding cavities. The shafts of the bones may be considerably altered in shape, increased in size, and altered in density. The associated tendons are frequently dislocated from their course beside the articulations, and atrophied or actually absorbed; and the corresponding muscles are similarly atrophied. Bursæ in the neighbourhood of joints may be distended with fluid, and contain fibro-cartilaginous bodies. The anatomical changes in this disease frequently present a remarkably symmetrical distribution.

Pathology.—A diversity of opinion still prevails upon the essential nature of rheumatic arthritis. The view most generally held at the present time appears to be, that it is a disease distinct from rheumatism and gout, with which it was confounded until the time of Haygarth (1805). Quite recently Mr. Hutchinson has shown that, in a certain number of instances, there is an element of gout in the disease, as evidenced by the family and personal history of the patient, and by the occasional presence of urates in the articular structures *post mortem.* The writer's experience is almost entirely in favour of the strictly *rheumatic* nature of the disease, as was maintained by Todd. In a large proportion of cases he has found that the morbid process started in an attack of ordinary acute rheumatism; an observation which is entirely in accord with the account of the origin of rheumatic arthritis given by Dr. Adams, of Dublin, in his classical work on this subject. In numerous instances the family history is distinctly rheumatic. The writer has also found the heart diseased in a much larger proportion of cases than is usually stated in accounts of the disease. Finally, he has found that no line can be drawn between acute and sub-acute cases of rheumatism; between sub-acute and chronic cases of rheumatism; or between chronic rheumatism and so-called 'rheumatic arthritis,' the latter being only a more severe development of the former. Whatever, therefore, the essential nature of rheumatism may be, the writer holds that all the conditions named are expressions of one morbid process, which differ from each other chiefly in intensity and the manner of their evolution.

Symptoms.—The symptoms of rheumatic arthritis in its condition of full development are exceedingly characteristic. The patient complains of pain and stiffness in connection with one or more joints; and on examination these are found to be swollen, more or less distorted, and tender. The history of these changes in the joints proves to be that, either in consequence of an attack of acute rheumatism, or not, first one and then others of the articulations became painful, tender, hyperæmic and swollen; that the resulting enlargement had not completely disappeared before the acute symptoms recurred; and that, by a repetition of similar acute or subacute attacks, the joints have reached their present condition. Thus the disease, whilst chronic in its course, consists essentially at first of recurrent acute, or subacute, attacks, which increase in frequency whilst their effects persist, and so finally become fused as it were into a continuous whole.

The *local* symptoms and signs vary with the particular joint affected; but in every instance they are chiefly these—pain, tenderness, creaking on movement, impairment of mobility, enlargement, and deformity. The pain is generally distressing, and, by its continuousness and severity, may render the patient's life miserable, especially as it increases at night and prevents sleep. It is aggravated by movement, and there is tenderness on forcible disturbance of the articular surfaces. Creaking or crepitation, audible and palpable, is a highly characteristic feature, which can be elicited and appreciated either by the patient or by the practitioner, and in the case of large joints may be so loud as to be audible at a distance.

The mobility of the affected joints becomes more and more impaired as the disease progresses —at first on account of pain, afterwards in consequence of anatomical changes. Thus the various joints may become fixed by a 'false' (very rarely a 'true') anchylosis, so that the hands cannot be closed; the wrists are immovable; the arms can hardly be removed from the side; the jaws are fixed; the head cannot be rotated; the patient may be unable to sit; and the knees, ankles, and toes may be similarly impaired in function.

The variety of deformity is almost endless; and the particular character it assumes depends as much on the joint involved, as on the nature of the process itself. Thus the knee, elbow, wrist, and knuckles may present considerable intra-articular effusion, especially in the earlier stages; whilst the shoulder, hip, and intra-phalangeal joints exhibit more limited swelling and 'drier' signs. The terminal digital joints become cubical or 'nodous'; the middle digital joints become spheroidal in outline, or are partially dislocated backwards or forwards; and the knuckles are the seat of a peculiar, oblique dislocation of the fingers towards the ulnar side. The lower ends of the radius and ulna project backwards, and give a full appearance to the dorsum of the wrist, which may be further increased by carpal and bursal enlargements. The elbow-joint is swollen; and bursal collections—fluid and solid —develop over the olecranon. The shoulder presents signs of wasting, rather than of enlargement, due to atrophy of the deltoid and other muscles; the head of the humerus at the same time lies unnaturally forwards and upwards; and a corresponding depression is apparent behind. At the hip-joint the disease gives rise to flattening of the buttock, shortening of the limb, and eversion of the foot; enlargement can sometimes be felt in connection with the head of the bone and acetabulum; occasionally the patient may be not only lame but unable to sit, and must accordingly either stand or lie constantly. The knee is enlarged by the presence of considerable effusion in the earlier stage; and when this afterwards becomes absorbed, local bony growths are easily felt, giving increased breadth to the patella, and forming sharp crests at the lateral margins of the articular surface of the condyles. The disease, as it affects the ankle and foot, does not require special description. At the temporo-maxillary articulation rheumatic arthritis gives rise to obvious enlargement in front of the ears, and possibly to distortion or asymmetry of the chin. Prominent nodular swelling is the principal sign of the disease at the sterno-clavicular articulation. In the spine it produces rigidity chiefly, as well as pain locally and down the arms, and leads to stooping in various attitudes.

The *general* condition of the subject of rheumatic arthritis, when it is advanced, is one of debility and anæmia. The face is pale and expressive of suffering; the complexion is muddy. The skin is peculiarly inactive, and rarely perspires; the patient looks pinched, and complains of a feeling of cold; the extremities are often miserably cold and livid; and the palms of the hands are damp or even soppy. Bodily activity is greatly impaired, by interference with the movements of the limbs; in many instances the patient is completely crippled and bed-ridden. Even the voice and the hearing may be impaired, from involvement of the laryngeal and auditory articulations. The various bodily functions are feeble, and frequently deranged; and although the mind may be active, the condition is rendered wretched in the worst cases by pain and helplessness.

Course and Terminations.—Unless the disease be treated early, the course is essentially progressive towards deformity. Death from rheumatic arthritis is rare; its other distressing effects have been sufficiently indicated.

Diagnosis.—The diagnosis of rheumatic arthritis necessarily depends upon the view entertained of its pathology. If considered a distinct disease, it is, as a rule, easily separated from gout by the entire absence of tophi in the joints and ears; by the history of the disease; and in doubtful cases by the absence of uric acid in the blood. From chronic rheumatism, as ordinarily defined, it is diagnosed by the amount of deformity present; but the writer holds that the two conditions are identical. Chronic synovitis of traumatic or constitutional origin may be occasionally mistaken for rheumatic arthritis, but the presence of the latter disease in several joints, probably symmetrically, should remove all doubt. Rheumatic arthritis of the hip and shoulder has probably been frequently described as 'dislocation' and 'intracapsular fracture.'

Prognosis.—The prognosis of this disease is favourable as regards life; but unfavourable as regards cure, comfort, or ability to follow active bodily employment. The prognosis is much better in the rich, who can seek relief by change of climate in the earlier stages, than it is amongst the poor, in whom the disease must in a measure be allowed to pursue its progressive course.

Treatment.—The treatment of rheumatic arthritis must be applied in two directions; first, to arrest, if possible, the morbid process, and, secondly, to relieve the distressing symptoms. In a large number of cases the second indication only can be fulfilled, for the disease is frequently too advanced, or the circumstances of the patient are too poor, to afford a prospect of cure.

In the *early stages* of the disease much can be done by energetic treatment, which must be partly constitutional and partly local. If circumstances permit, the patient should be advised to visit, according to the season of the year, either the baths of this country, of Germany, or of France

in summer; or the Algerian springs, the French Riviera, or Italy in winter. Buxton, Bath, and Strathpeffer are the best home baths. Aix-les-Bains, Aix-la-Chapelle, Baden-Baden, and Wiesbaden may be recommended from May till September. The other places named, especially Hammam R'Irha in Algiers, are winter resorts. A voyage to the tropics or subtropics will suit other cases. The climate of Egypt proves beneficial in some instances; and advantage may be taken there of the Eastern method of treating rheumatic affections by means of baths and rubbing, which are undoubtedly successful in some cases. *See* MINERAL WATERS.

The most valuable internal remedies for rheumatic arthritis are cod-liver oil, iron, and arsenic. Cod-liver oil should be taken regularly if the digestion permit. Either iron or arsenic, or the two combined, should be taken in full doses for periods of weeks or months, and their effect carefully noted. Dr. Garrod especially recommends the syrup of the iodide of iron.

The diet should be carefully ordered. Whilst all excess is avoided, as well as indulgence in malt liquors, wines, and rich indigestible dishes, a generous supply of mixed animal and vegetable food will be found to be most suitable. The clothing must be warm, flannel or other woollen material being worn both summer and winter. The greatest possible care must be exercised to avoid cold and damp, in the choice of a residence and in the routine of daily life.

The *local* treatment is to be considered of hardly less importance than the constitutional. On the first appearance of the disease, counter-irritation should be freely applied to the joints. The most convenient form is iodine paint, which should be used so freely that the skin becomes of a mahogany colour, and desquamation follows in a few days. The joints should be carefully protected by cotton-wool or flannel. Between the subacute attacks of the disease, efforts should be made to restore the healthy nutrition of the affected joints. Whilst the internal treatment already indicated is persevered with, or a trial is given to guaiacum or iodide of potassium in obstinate cases, counter-irritation should be replaced by a method of less severe but systematic stimulation. The joints that can be easily reached should be thoroughly fomented night and morning, by wrapping a piece of cambric or flannel around them, and sponging water over this, as hot as can be borne. After several minutes of such treatment the joint should be thoroughly rubbed, either with a stimulating liniment, such as the turpentine or acetic turpentine liniment, with a mild mercurial ointment, or with some bland oil, such as cod-liver oil or goose-grease. The effect of such local treatment, if pursued steadily, is in the experience of the writer often remarkable, mobility being restored in cases where the joints have been useless for months.

In very *advanced cases*, especially in old subjects, it is manifestly impossible to expect much improvement. Anodyne treatment is then chiefly called for, and a good deal can be done in this direction by well-chosen local applications, the preparations of opium being of course the most successful. The general health will demand support by a well-regulated diet, and the internal treatment suggested above.

J. MITCHELL BRUCE.

**RHEUMATIC FEVER.**—A popular synonym for acute rheumatism. *See* RHEUMATISM, Acute.

**RHEUMATIC GOUT.**—A popular name for several kinds of chronic joint-disease, especially rheumatic arthritis and chronic rheumatism.

**RHEUMATISM, Acute** (ῥεῦμα, a fluxion).—SYNON.: Rheumatic Fever; Fr. *Rhumatisme articulaire aigu*; Ger. *Hitziger Gelenkrheumatismus.*

DEFINITION.—An acute febrile disease; caused by certain obscure climatic and diathetic influences; and characterised by pyrexia, sweats, and acute shifting inflammation of the joints and other structures.

ÆTIOLOGY.—*Predisposing causes.*—Of the predisposing causes of acute rheumatism, the most important is inheritance, which can be traced in 27 per cent. of all cases. Previous attacks increase the liability to a return of the disease; but there is a limit to predisposition from this cause after several attacks. The great majority of first attacks occur in persons under the age of thirty; and the larger proportion of these between the ages of sixteen and twenty-five. At the same time, rheumatism is by no means uncommon either in children or in persons past middle life. Rather more males than females suffer; but, apart from other circumstances, the influence of sex is inconsiderable. Occupation and social position are important as predisposing causes; laborious outdoor occupations, in which persons are exposed to chills, poverty, and the many evils associated with these, contributing to furnish the largest percentage of cases. Certain regions or districts, or even parts of districts, appear to deserve the name of 'rheumatic,' from the number of residents who suffer from the disease, and from the probability that a person, otherwise predisposed to rheumatism, will be more likely to be attacked if he enter such an area.

*Determining causes.*—The most common exciting cause of acute rheumatism is exposure to cold and wet; or, to express the same fact in other words, the disease has an intimate ætiological relation to weather, season, and climate. Some apparent exceptions to this statement really accord with it; thus acute rheumatism is not uncommon in warm weather, on account of the frequency of chills from over-heating. Rheumatism may suddenly make its appearance after a sprain or other injury to a joint, which may also determine the distribution of the disease in the articulations. Similarly, the order of invasion of the several joints is due in some instances to the amount of exercise to which they have been respectively subjected. An attack of acute rheumatism is occasionally referred to derangement of digestion, and of the functions of the liver, especially in subjects who have previously suffered. Indulgence in abundant rich or indigestible food will certainly determine a relapse in persons convalescing from the disease, and may possibly induce an attack in the predisposed.

Depressing bodily or mental influences may excite rheumatism under similar circumstances. Exhaustion by lactation, or by chronic uterine diseases, tedious convalescence, the puerperal state, and possibly simple despondency, may act in this way in different instances.

Anatomical Characters.—The *post-mortem* appearances in acute rheumatism are, on the whole, remarkably negative, not so much on account of the absence of morbid changes in the affected parts, as from the slight degree to which these changes have advanced. On opening an affected joint, we find moderate hyperæmia, with occasional ecchymosis, of the synovial membrane and fibrous tissues connected with the articulation; a somewhat opaque, granular, swollen appearance of the synovial surfaces; and a considerable amount of inflammatory effusion. This effusion is generally a thin, clear, alkaline, albuminous fluid; occasionally turbid, with flakes of fibrin and cell-products; rarely purulent. The cartilages connected with the joint probably share in the inflammatory changes, especially if the process be severe; and the associated soft parts, including the tendons and their sheaths, are very frequently hyperæmic, and the seat of effusion.

A fatal termination in acute rheumatism is always the result of some complication, intercurrent disease, or injury; and in such cases the non-arthritic lesions are necessarily the most important. Of these the most frequent are congestion or inflammation of the lungs, and inflammation of the heart and pericardium. Inflammation of the pleura is much less commonly found; and in rarer instances inflammation of the peritoneum, larynx, testes, and renal tubules. When pyrexia has been great the solid viscera present granular degeneration, and are prone to rapid decomposition; and in cases of hyperpyrexia the blood is fluid. The blood has frequently been subjected to chemical analysis, but without any positive result of a pathological kind. The reaction of the liquor sanguinis is alkaline, as in health. The fibrin has been said to increase in amount to 1 per cent. instead of ·2 per cent. The amount of urea is not above the normal. Neither uric acid, lactic acid, nor any other abnormal principle has been found in the blood during an attack of acute rheumatism.

Pathology.—The pathology of acute rheumatism is still obscure, and in the present article it will be sufficient to enumerate the principal theories upon the subject.

1. *Lactic acid theory.*—Lactic acid accumulates in the body, and the symptoms are directly referable to the action of this poison upon the system (Prout, Todd, Richardson).

2. *Nervous theory.*—Chill of the peripheral parts of the body, especially of the skin and joints, causes disturbance of corresponding parts of the central nervous system; and this gives rise to pain and vaso-motor (?) or trophic changes of the same peripheral parts, and to fever (Canstatt; Seitz).

3. *Combination of* 1 *and* 2.—Chill causes accumulation or retention of lactic acid; this acts on the central nervous system; and the disordered nervous centres react upon the joints, &c., as in 2 (Senator).

4. *Combination of* 2 *and* 1.—Chill disturbs the nervous system; this disturbs nutrition generally; lactic or some other acid is retained, and acts as a poison, as in 1 (Fuller).

5. *Infective theory.*—Chills are attended with the entrance of micrococci into the system, and endocarditis is the result. The joint-symptoms are secondary and embolic, as in pyæmic arthritis (Hueter).

6. *Germ theory.*—The disease is due to the presence in the blood of a vegetable organism of definite characters—*Zymotosis translucens* (Salisbury).

7. *Malarial theory.*—Rheumatism is due to the presence in the system of a poison, which is of the nature of a miasm, entering from without. This miasm is generically allied to, but specifically distinct from, the miasm of malarial fever (Maclagan).

Without attempting to criticise these theories, we may conclude that, whilst the true pathology of acute rheumatism cannot possibly be settled until the essential nature of fever is thoroughly understood, the most promising directions from which we may expect light to be thrown upon it are, first, the effect on the system of organic poisons, whether introduced from without, or produced within it as the intermediate products of nutrition; and, secondly, the intimate relation of the nervous system to the body-heat, to the skin, and to nutrition.

Under these circumstances it is impossible at present to estimate the respective significance and relative importance of the phenomena constituting the 'disease' rheumatism. But for the purpose of intelligible description, it is necessary that such of the phenomena as are only occasional in their appearance should be separated from such as are constant; and that the latter should be treated as the essential symptoms of the disease, whilst the former are regarded as complications. The constant phenomena of acute rheumatism, thus considered, are probably but three, namely, fever, sweats, and arthritis; whilst inflammation of the cardiac structures, lungs, and serous membranes would be included under the head of the occasional phenomena or complications. This plan of description of acute rheumatism will be adopted in the present article, for convenience' sake only, and will imply no actual criticism of the theories of the pathology of the disease just enumerated; athough with several of them it necessarily cannot agree.

Symptoms. — **General description.**— After suffering for a time from aching pains in the limbs and trunk, flying pains and stiffness in the joints, malaise, chilliness, and sore-throat, the subject of an attack of acute rheumatism is seized with severe pain in one or more of his joints, experiences a chill or slight rigor, and is found to have several degrees of fever. The local and general symptoms quickly develop; and a striking picture is presented by the patient. He lies motionless in bed, flat on his back, with every joint at rest and carefully guarded. The neck, back, and legs are straight; the arms folded across the body, or extended along either side; the eyes alone are moved, and follow the practitioner as he approaches the bedside. The face is found bedewed with perspiration; and the rest of the

body is profusely covered with sweat, which gives off a sour, acrid odour. The countenance is full, heavy, and expressive of a subdued feeling of pain and dread of movement; the complexion may be of a dirty, sallow colour, or even slightly jaundiced; and the cheeks are probably flushed. The affected joints prove to be swollen and red; hot to the touch; remarkably tender; and the seat of pain, which varies much in character and intensity. One joint, or several, or nearly every joint in the body, may be found in the condition just described. The patient complains of a feeling of illness, thirst, and anorexia; the tongue is foul and creamy; the throat is somewhat sore; and the bowels are irregular. The pulse is frequent, weak even to dicrotism, and rather full. Respiration is somewhat accelerated; and there may be slight cough. The urine is scanty, high-coloured, very acid, and loaded with lithates. The skin is covered with perspiration, congested, and warm; and probably presents sudamina or miliaria in places. The patient's mind is perfectly clear, and his attention appears to be chiefly directed to the maintenance of the affected joints in the most easy position possible. Until successful in this endeavour he is restless and miserable; and even if he have obtained temporary relief and have gone to sleep, he is liable to be suddenly aroused by involuntary spasm of the muscles connected with the affected joints. The pain is so severe when the disease is at its height, that sleep cannot be obtained.

Such is the condition of a patient suffering from a fully-developed attack of uncomplicated rheumatism. For a period, which would appear to be perfectly indefinite, these symptoms continue, varying considerably in intensity from day to day. But whilst the condition thus persists, the remarkable and characteristic fact is constantly observed in this disease, that the arthritic phenomena are at once transient and erratic, that is, that the rheumatism passes rapidly from joint to joint, the joints which were affected the one day being nearly well the next, and a fresh series swollen and painful. In this manner most of the joints of the limbs may have been affected in the course of a week, and the number of joints simultaneously affected is very variable. Thereafter the disease may make a further invasion of joints previously involved, and that repeatedly.

At last, the rheumatism appears to have exhausted itself; no fresh joint is attacked; and the parts last affected lose more or less completely the final traces, both objective and subjective, of the severe process which they have undergone, being for some time, however, stiff, feeble, and painful on movement. The patient now assumes a less constrained posture; the other symptoms decline; the perspirations disappear; the countenance becomes more bright; spirits and strength return; the tongue cleans, and the appetite is rapidly restored; the pulse falls in frequency; urine is passed in greater quantity, is less acid, and no longer deposits urates; and the temperature falls to the normal.

The patient being convalescent, a relapse of the disease by no means uncommonly occurs, after a few days or weeks; and that in any degree, from a slight swelling, redness, and pain of a single joint, to a combination of the various symptoms, as severe as the first, or possibly more so.

**Analysis of symptoms.**—*Invasion.*—In the great majority of cases the patient gradually 'sickens for' acute rheumatism for several days before the symptoms are fully declared. He feels ill and out of sorts, chilly, indisposed to eat or work; sleeps badly; complains of slight sore-throat, aching pains in the limbs, and shooting shifting pains in the joints; and presents a sallow, patchy complexion, and a dull, heavy yellowish appearance of the eyes. Altogether, the condition of the patient is very much that of the subject of a severe catarrh; the tongue, digestion, bowels, urine, and pulse presenting the ordinary characters of moderate fever. On careful examination it is found that the pains are of two kinds. The first kind are by far the more severe, and consist of severe muscular aching in various parts of the limbs and trunk; whilst the second kind are of the nature of flying pains in the joints or associated parts. The muscular aching appears to be similar to, or even identical with the 'break-bone' pains which are familiar in common catarrh, and in the invasion stage of some eruptive fevers. They are, therefore, not characteristic. The flying pains, which are, however, not always present—especially in first attacks, are actually situated in the articulations, for instance the ankles, knees, or wrists, and are of the nature of sharp twinges, suddenly leaving one joint to return as quickly in another. Towards the end of the stage of invasion, these pains become less 'shifting;' and when, as the patient will say, they have 'settled' in one or more joints, the rheumatism has passed into the second stage, that of the declared disease. Stiffness of the joints may also be present, especially in recurrent attacks.

In the invasion period the skin does not yet present the perspiratory activity which is so characteristic a symptom of acute rheumatism; but rather a moistness, greasiness, or oiliness, with heat and some congestion. The temperature is raised one degree or more. The sore-throat, which consists in pharyngeal catarrh, follicular tonsillitis, or even actual acute suppurative inflammation, is remarkably characteristic. The milder forms are soon lost in the more urgent symptoms.

The duration of the stage of invasion of acute rheumatism varies greatly, the flying pains in the joints 'settling' much more quickly in some cases than in others. In a small proportion of cases the disease is so rapidly developed that the stage of invasion is wanting. The patient on waking in the morning finds one or more joints affected; or he appears to be struck down during the day without the slightest warning; and instances are not uncommon in which persons, thus suddenly seized with acute rheumatism, have been removed to hospital, for supposed sprain or fracture of the limbs. In rarer instances the feverish symptoms of the invasion stage may be well-marked without any pains whatever.

**Declared disease.**—1. *Phenomena connected with the joints.*—The physical signs presented by a joint affected with acute rheumatism naturally vary much. The *swelling* is usually considerable, and is chiefly referable to effusion into the cavity

of the articulation, fluctuation being frequently discoverable. It is rare for the peri-articular effusion to be so abundant as to yield pitting on pressure. The amount of intra-articular effusion (as well as the pain) greatly influences the position of the joint, but most joints are maintained in a position a few degrees removed from extension. Careful examination will determine the increase and the disappearance of the swelling, as the joints are attacked and recover respectively.

*Pain* is the most distressing of all the symptoms in uncomplicated rheumatism. It is always severe, and sometimes almost unbearable; but it varies with the different joints, and with the degree and duration of their involvement. In degree it may be said to increase steadily for several hours; it remains excessive for a time; and it then slowly and steadily declines. Its character is very differently described by different sufferers. When a joint is attacked by rheumatism, the first sensation felt by the patient is one of soreness on movement. As the condition develops, the soreness increases to an ache of a subdued, throbbing character. In the course of a few hours the ache 'works up' into an intense pain, apparently associated with a feeling of cramp, the slightest movement of the articulation being almost unbearable. The severe pain now gradually declines—in some instances from the time the swelling reaches its height. After several hours the only pain that remains is a distressing sensation as if the parts had been severely bruised; and the effusion which accompanied the excessive pain having declined along with it, rest of the joint again becomes all-important, the very slightest movement being sufficient to restore the wearying ache. Finally, the pain completely disappears, and nothing remains beyond a feeling of stiffness and helplessness when the joint is moved.

Whilst the course of the pain of an acute rheumatic attack is usually such as has been described, it is greatly modified by a variety of circumstances, such as the particular joint affected, the age and sex of the patient, the condition of the nervous system, and the presence of certain temperaments. In some instances the pains are increased at night.

*Tenderness* is a constant and well-marked symptom of acute rheumatism. Reference has already been made to the effect of movement on the pain in its different stages, especially towards the end; and to the characteristic posture and anxious expression of the patient, who suffers intensely from the slightest shake of the bed, or even a footfall on the floor. Tenderness finally declines into the feeling of stiffness.

The *redness* of a rheumatic joint is a simple pink blush of erythema, very rarely purpuric. Its intensity varies much with the deep or superficial situation of the articulation, and it is therefore most marked in connection with the joints of the hands and feet, the knees, and the ankles.

*Heat* of the affected joint is a well-marked objective sign of acute rheumatism. The articulation feels decidedly warmer to the hand than the surrounding parts; and this observation is confirmed by the thermometer.

The *electrical sensibility* of the skin connected with an acutely rheumatic joint has been described by Drosdoff as being remarkably diminished, the area of nervous alteration corresponding exactly with the area of redness, and its duration with the duration of the other local signs and symptoms.

The *favourite joints involved* in acute rheumatism are the larger articulations, especially the knees, ankles, wrists, shoulders, and elbows; the hip joint less frequently than the others. The fingers come next in order of frequency; then the toes; whilst the remaining articulations are more rarely affected.

Corresponding rather closely with the frequency of attack is the favourite *order of invasion*; the ankles being more frequently the first to be involved, then the knees, and so on. In other instances it is observed that the disease passes along the joints of the lower limbs, including the hips, to those of the upper limbs; frequently its distribution is symmetrical bilaterally; whilst in some cases it is unilateral, the homologous joints of the upper and lower limb being simultaneously invaded. The smaller joints suffer, as a rule, towards the termination of the attack.

2. *Disorders of neighbouring muscles.*—The muscular pains of the stage of invasion of acute rheumatism disappear in the declared disease, or are lost in the presence of more severe symptoms. They are replaced, however, by pains in the soft parts of the limbs related to the affected joints, especially the muscular insertions and fasciæ; and even the whole limb may ache, with much stiffness and a feeling of utter powerlessness. Painful twitchings are also common, especially during sleep; and when the acute pain has passed off, marked muscular debility remains behind.

3. *Temperature.* — Acute rheumatism is attended by well-marked pyrexia, but this, like the disease as a whole, is variable in degree, course, and duration. The sudden invasion of the several joints, their speedy relief, the alternation of extreme bodily distress with comparative comfort, and especially the variety of pyrexic diseases with which the rheumatism may be complicated, would hardly lead us to expect a typical temperature curve. In uncomplicated cases, however, the fever follows a tolerably definite course. Pyrexia makes its appearance at invasion; it continues as long as the local symptoms preserve an acute or subacute character; and with them it declines and disappears. The *degree* of the pyrexia, in the great majority of cases, is in direct proportion to the severity of the joint-disease. Mild local symptoms—that is, moderate pain, short duration of symptoms in any given joint, and a small number of joints affected, are accompanied by moderate fever, ranging from 99° to 102° Fahr. On the other hand, severe local symptoms—that is, severe pain, the full development of the several signs in the affected parts, and the simultaneous involvement of several joints, are attended by a temperature of 101° to 104° Fahr. In another, but very small class of cases, the temperature, whatever it may previously have been, rises rapidly to an alarming height, so as to be entirely out of proportion to the joint-symptoms,

which either continue as before, or even disappear. This condition of hyperpyrexia is regarded in the light of a complication, and as such will be presently described.

The *type* of the fever in uncomplicated cases is remittent, the thermometer rising ·25°, ·50°, or 1·0°Fh. in the evening. The primary elevation of temperature at the commencement of the disease is somewhat rapid; the decline or defervescence is decidedly more gradual, although it is generally irregular, being almost invariably broken by temporary rises, or interrupted by the supervention of some pyrexic complication. The occurrence of a relapse is marked by a return of pyrexia, which probably presents the same general characters as before.

4. *Skin.*—Profuse acid sweats constitute one of the characteristic phenomena of acute rheumatism. The brow is covered with drops which trickle down the face; and the whole body perspires profusely, and is bathed in an atmosphere of wet steam. Although usually universal, the sweats may sometimes be unequally distributed. It is doubtful whether any relation can be traced between the amount of perspiration and the hour of the day or night, the temperature, or the pulse; but it perhaps varies directly with the severity of the pain. The sweats continue throughout the whole attack, making their appearance at an early date and disappearing gradually with the subsidence of the other symptoms. They do not intermit in the striking way of the sweats of the hectic or septic states, unless towards the end of a severe protracted attack, when the patient is greatly debilitated; but at certain parts of the day the skin may be found to be perspiring less freely, or even to be perfectly dry. The sweat of acute rheumatism possesses a peculiar sour, acrid smell; and this is so powerful, and pervades so thoroughly the neighbourhood of the patient when the blankets are disturbed, that the diagnosis of the disease can frequently be made from it alone. Like the sweat in health, it is acid in reaction, rarely alkaline from decomposition. No other test can be readily applied to it clinically. The rheumatic patient may complain of the unpleasant, but never of the 'weakening' effect of the perspirations which is observed in hectic fever; on the contrary, he may describe them as bringing great relief to the bodily condition. In less acute cases the skin may present a shiny or greasy appearance, rather than actual perspiration. When the sweats are severe, sudamina make their appearance, especially about the trunk; and in some cases the skin is covered with a profuse eruption of miliaria.

5. *Digestive system.*—The tongue is covered with a thick, white, moist fur, which varies closely with the rheumatic condition, and serves as a ready indication of the same. The thickness of the coating is sometimes very great. Occasionally the tongue is dry; very rarely brown, baked-looking, or cracked. The sense of taste is, in a great measure, lost; the mouth is parched; thirst is urgent and difficult to satisfy; and the reaction of the saliva, or, more correctly, of the fluids of the mouth, is said to become acid. Appetite is lost, until the disease begins to decline, when hunger returns very early and urgently. Sore-throat occurs in some cases during the declared disease, but is much less common than in the stage of invasion. Sickness is rarely present. Dyspepsia, attended with flatulence, is common, unless the most digestible food only be given. Irregularity of the bowels is characteristic of acute rheumatism, either constipation or diarrhœa being almost constantly present; and the two conditions frequently alternate. Diarrhœa is perhaps more common in first than in subsequent attacks. The motions are dark and foul. Pains in the belly are by no means rare, and are frequently connected with diarrhœa, but they occur also in constipation; and at times they are accompanied by attacks of distressing flatulence.

6. *Circulation.*—The circulatory symptoms proper to acute rheumatism are modified by complications affecting the heart in a very large proportion of cases. When no special circulatory complication exists, the pulse is regular, 80 to 120, full, sometimes hard, sometimes soft, or even dicrotic; but it naturally varies much with the severity and stage of the disease. The effect of the various complications on the pulse will be presently described.

7. *Respiratory system.*—The frequency of the respirations in uncomplicated rheumatism is somewhat increased; slight cough is occasionally present; and under these circumstances a few dry rhonchi may be heard over the chest. On the other hand respiratory complications may be of a serious and even fatal character, and will demand consideration in their proper place.

8. *Urine.*—Throughout an attack of acute rheumatism the urine is scanty, high-coloured, and strongly acid; and it deposits a quantity of urates. Albuminuria is rare. Quantitatively examined, the urine is found to contain an actual excess of urea, and a considerable (but probably only a relative) excess of uric acid, colouring matter, and sulphates; the water is below the normal amount; and the chlorides are diminished, although less so than in pneumonia. Lactic acid has never been found in excess. Any marked departure from these characters of the urine, especially in the appearance of more than a passing trace of albumin, is to be considered as a complication of the rheumatism.

9. *Nervous system.*—As a rule, consciousness and clearness of intellect are preserved throughout. Delirium is very uncommon; and when either delirium or stupor supervenes, it will generally be found that, in otherwise uncomplicated cases, the temperature has risen to an excessive degree. Very rarely the pyrexia remains moderate in these circumstances, and such cases have been described by the name of 'cerebral rheumatism.' There is generally great distress of mind in acute rheumatism; and in other than first attacks, the previous experience of its protracted course and dangers, and the recollection of the pains and other sources of bodily discomfort greatly affect the patient, and produce an amount of anxiety which is almost characteristic of the disease. Sleep is either impossible, or at best is constantly broken and unrefreshing, when the pain is severe.

10. *Expresssion.*—The debility or prostration, which forms an important element of fever from whatever cause, is present in acute rheumatism, but it is in a great measure obscured by the ex-

pression referable to pain, and to the effort to preserve an easy position. Towards the end of an attack, when pain is subsiding and movement is comparatively easy, the patient and the practitioner begin to appreciate the degree to which the bodily strength has been reduced. This loss is always great, and is sometimes extreme, varying, of course, with the severity and duration of the disease.

Varieties.—The description just given applies to a fully-developed attack of acute rheumatism, without complication, of indefinite but not protracted course, and of favourable termination. It is only a minority of cases, however, that are of this nature. Occasionally the symptoms are very mild or the attack very short, in which event the rheumatism is said to be *subacute*. Again, as nearly as possible every second case proves to be *complicated* with some affection of the viscera, especially the organs of circulation and respiration. These departures from the 'typical' course of acute rheumatism, as it is called for the sake of description, will next be considered.

**Subacute rheumatism.**—Under this name are comprised a variety of cases of the disease, which, whilst of comparatively little severity, exhibit the greatest possible differences in their other clinical characters. Several well-marked groups of these may be distinguished, and demand separate consideration.

(*a*) The *first* group of subacute cases is one in which the duration of the disease is unusually short—probably from one to three days. The number of joints affected is very small; and the general symptoms appear to be arrested before attaining any considerable severity.

(*b*) In a *second* group of subacute cases, after exceedingly mild invasion-symptoms, a single joint only is attacked, with little pyrexia, whilst the skin presents a shiny or oily dampness rather than true perspiration. The rheumatism disappears in a few days; or it shortly relapses in the same or in some other joint. This form of subacute rheumatism may be difficult to diagnose from gout.

(*c*) Widely different from the foregoing is another and the most common variety of subacute rheumatism. Such are many of the *recurrent* cases of the disease, and of the instances of first attacks in old subjects. It may be stated broadly that the first attack, or first and second attacks, of rheumatism are more severe than subsequent ones; that the severity diminishes with each recurrence of the disease; and that persons attacked for the first time after middle life, suffer less than younger subjects. In all these cases, the phenomena connected with the joints, and the general symptoms, including the pyrexia and the sweats, are mild in degree, although by no means of short duration. In recurrent cases the patients are frequently the subjects of chronic heart-disease, in whom exposure to some of the determining causes of rheumatism has lighted up fresh endo- and peri-carditis, and therewith moderate fever and subacute rheumatism of the joints. The anxiety of the practitioner will be confined to the condition of the heart; but during the progress of the complaint, joint after joint may become painful, tender, slightly swollen, and red.

(*d*) *Lastly*, there is a large and well-marked group of subacute cases of rheumatism in which the disease runs what may be called a *latent* course, and which occur especially in children. The joints are so slightly affected that the characteristic signs and symptoms of rheumatism may be entirely overlooked. Children frequently pass through an attack of acute rheumatism, without the true nature of the complaint being suspected by their medical attendant; and in other instances the diagnosis is first made on the discovery of one or other of its familiar complications, notably heart-disease. The child is feverish, and complains of pain and tenderness in the limbs. Moderate swelling and redness of the affected joints pass unheeded in the full and high-coloured body of the patient; and pain and tenderness in these subjects are either entirely disregarded, or referred to 'growing,' or to 'a cold.' Lastly, the sweats are much less profuse, or entirely wanting, the skin being hot with several degrees of fever. Whilst the disease in children runs this exceedingly mild course, and one which seldom exceeds a week in length, it is accompanied, in a comparatively large proportion of cases, by acute cardiac disease—a fact which greatly increases the necessity for its early diagnosis. A more completely latent form of acute rheumatism has been described by Graves, in which articular symptoms are entirely wanting, whilst the other symptoms may be of the usual character and follow the usual course.

When these four prominent groups of subacute rheumatism have been described, there still remain a large number of mild cases, which are too indefinite to be treated of in a general article. All possible varieties of the disease will be encountered in practice, according as, on the one hand, the 'typical' course is pursued, or, on the other hand, the disease assumes a subacute character.

Course, Duration, and Terminations.—The course of acute rheumatism is extremely indefinite. The average duration *of acute symptoms* under expectant treatment has been estimated at nine days; it is probably rather less under certain other methods of treatment; and it is much prolonged by neglect. The entire duration *of an attack* is much greater than this, and necessarily less definite, namely, two to six or even ten weeks; and, speaking broadly, it increases with the age of the patient, up to middle age. Convalescence is generally protracted (before the health is perfectly restored); and it is very common to hear persons who have suffered from acute rheumatism state three or four months as the time they were 'ill.' Convalescence is accompanied by desquamation of the hands and feet, and perhaps of the body generally; and may be marked by obstinate anæmia. In many cases stiffness, pain, and weakness remain in the joints and neighbouring muscles.

The great majority of cases of acute rheumatism ultimately end in recovery, the proportion of deaths as the immediate result of an attack being only about four per cent. On the other hand, a large number of persons suffer from remote effects of the disease, many of which are not only distressing, but likely to lead to death. Of the immediately fatal cases, the larger proportion are associated with, if not actually due

to, acute disease of the respiratory organs. The fatal cases which present cardiac disease, especially acute pericarditis, are scarcely less numerous. Altogether it may be said that from a half to three-fourths of all cases of death during acute rheumatism are referable to acute cardiac and pulmonary disease, either separately or combined. It is doubtful whether acute rheumatism *per se* ever proves fatal—that is, whether any patient dies from excessive pain, sweating, and consequent exhaustion. Hyperpyrexia is the most common cause of death next to pulmonary and cardiac complications. In a small number of cases, meningitis, acute alcoholism, and other complications, to be mentioned presently, lead to a fatal termination.

The *remote consequences* of acute rheumatism are, on the whole, more serious than the immediate effects. In a few instances the disease leaves behind it a condition of joints which passes into 'chronic rheumatism' or 'rheumatic arthritis.' A more common effect is valvular disease of the heart, which, in the majority of cases, is referable to acute endocarditis occurring as a complication of rheumatism. It is impossible to estimate the number of cases of disease of the lungs, vessels, brain, kidneys, and other organs, which, in their turn, are caused by such heart-disease. It is also probable that the vessels suffer directly from the effects of rheumatism. When, in addition to these effects, we consider the remote effects of pneumonia and pleurisy, and of the other less common complications of rheumatism, as well as the liability to a return of the disease and its complications which seems to be engendered by a first attack, it is difficult to exaggerate the extent and seriousness of the ultimate results of this disease.

Complications.—Acute rheumatism is frequently accompanied by certain other affections, which modify its course and greatly increase its gravity. The appearance of these complications is in every case anxiously apprehended; and the prevention of the most serious of them is regarded as the chief indication in the treatment of the disease. The principal are—inflammation of the heart and pericardium; hyperæmia and inflammation of the lungs, bronchi, and larynx; inflammation of the various serous membranes; various nervous affections, such as chorea, meningitis, and mental derangement; erythema nodosum, and scarlatina; albuminuria; hyperpyrexia; hæmorrhages; and, lastly, various concomitant or intercurrent conditions.

The relations of these complications to acute rheumatism are very various. The largest and by far the most important group, comprising cardiac inflammations, pneumonia, pleurisy, peritonitis, erythema nodosum, chorea, and meningitis, can only be described as having an intimate but obscure *genetic relation* to rheumatism. This relation is indicated in many ways, such as the frequency of their occurrence during an attack of acute rheumatism; the comparative infrequency of certain of them in any other connection; the manifest analogy that exists between the parts affected in some of them and the joints; the direct increase of their frequency with the intensity of the general rheumatic symptoms, that is, of the cause of the disease; the transient and migratory character which they may present, alternating as they sometimes do with each other and with the arthritis; their occasional occurrence before the joint-symptoms, or even without them, or in the person of a blood-relation of a rheumatic subject; their amenability to anti-rheumatic treatment; and, lastly, their occurrence in the course of acute rheumatism as a part only of a manifestly general disease.

Other complications appear to be *effects* of rheumatism, such as albuminuria and mental disorder: and chorea is believed by some authorities to belong to this category rather than to the former. Scarlatina, dysentery, and profuse hæmorrhages are perhaps related to it *ætiologically*. Lastly, such conditions as bronchitis, hyperpyrexia, and delirium tremens are to be considered as merely *concomitant* or *intercurrent* diseases.

The chief of these complications must now be considered in detail, in the order of their relative importance.

1. **Cardiac complications.**—These are by far the most frequent complications of rheumatism, being present in no fewer than fifty per cent. of all cases. The percentage of acute cardiac disease is, however, less than this—almost certainly about one-third, the remaining cases being chronic, or chronic and acute cardiac disease combined. These numbers refer only to organic disease of the heart, namely, endocarditis, pericarditis, myocarditis, and the effects of these, singly or in combination. But, besides inflammatory affections, there may occur functional disorders of the heart, characterised chiefly by palpitation, cardiac distress, and the presence of various abnormal physical signs; and, according to some observers, the latter class are of as frequent occurrence as the former.

The circumstances under which cardiac inflammation most frequently makes its appearance in acute rheumatism are—first, and specially, early age, rheumatic children rarely escaping disease of the heart, youths seldom, and the liability rapidly diminishing after the thirtieth year; secondly, severity of the rheumatic attack—with which the liability to cardiac complication increases in direct proportion; thirdly, the female sex—women being more subject to rheumatic disease of the heart than men; and, fourthly, neglect of proper treatment during and after the attack.

The *time of appearance* of cardiac symptoms has been variously stated by different observers. As a matter of fact, they are generally discovered when the patient comes under observation; they certainly begin most frequently in the first week of illness; but they by no means uncommonly make their appearance in the second week, and may occur at any period.

Inflammation of the heart and pericardium are fully described under their appropriate headings (*see* Heart, Inflammation of; and Pericardium, Diseases of). The influence of the presence of cardiac complications on the course and prognosis of an attack of acute rheumatism, is so important as to alter the whole aspect of the case, and to prove the chief cause of anxiety. Affections of the heart are by far the most common cause of death from rheumatism, immediate and

remote; and even when they do not prove fatal, they constitute the most distressing of the remote effects of the disease.

2. **Respiratory complications.**—Diseases of the respiratory organs have been variously stated to occur in from one in every six to one in every sixteen cases of acute rheumatism; and in the larger proportion of immediately fatal cases they are the direct cause of death. The most common is pleuro-pneumonia; pleurisy alone the next; then pneumonia; and severe bronchitis, pulmonary congestion, and laryngitis are more rare. They may probably occur at any period of the rheumatic attack; but the most serious forms will necessarily appear towards the termination, for the obvious reason that they so frequently prove fatal. The supervention of acute respiratory diseases is, as a rule, easily recognised by the appearance of their several symptoms and signs.

3. **Hyperpyrexia.**—This is one of the most alarming complications of acute rheumatism, but happily one of the most rare. The condition is fully described in another article (*see* TEMPERATURE). Hyperpyrexia may occur at any period of the disease; generally when the symptoms are fully developed; but even during convalescence. The principal indications of the approach of hyperpyrexia, which it is of the last importance to recognise, are flushing of the face; brightness and restlessness of the eyes; an eager, excited expression and behaviour; disappearance of pain and swelling from the joints, and arrest of the perspirations; delirium; and increase of the general symptoms of fever. On the occurrence of any of these symptoms in an otherwise uncomplicated case of acute rheumatism, the temperature should at once be taken, and the observation repeated every half-hour. If the body-heat prove to be over 103°, and to be still rising, measures must be immediately adopted to prevent the hyperpyrexia, which is certainly threatening.

4. **Nervous complications.**—The reputed frequency of these complications has been greatly reduced since the discovery that the majority of the cases of so-called 'cerebral rheumatism' and 'rheumatic meningitis' are really instances of hyperpyrexia. These cases being excluded, the frequency of cerebral disturbance, in uncomplicated rheumatism, is not greater than in other pyrexial diseases. Cerebral embolism may occur from endocarditis; meningitis is very rarely observed; and a peculiar form of insanity has been described by German authors in connection with acute rheumatism. Delirium tremens occasionally supervenes when there is a history of alcoholism. Chorea bears a remarkable relation to acute rheumatism (*see* CHOREA). Occasionally it appears during an attack; and choreic twitchings may thus be the prominent symptoms during the first days of the illness, especially in children.

5. **Cutaneous complications.**—In a small proportion of instances, acute rheumatism, or a condition which practically cannot be distinguished from it, is associated with erythema nodosum; sometimes the arthritic symptoms and sometimes the skin-affection being the first to appear, and the two conditions being further associated with some of the complications already mentioned. Urticaria is less frequently seen in the same connections. A remarkable condition, in which arthritic symptoms are associated with purpura, hæmorrhages, vascular thromboses, and possibly ulcerative endocarditis, is known as *peliosis rheumatica*, or *purpura rheumatica*. *See* ERYTHEMA; PURPURA; and URTICARIA.

6. **Renal complications.**—Albuminuria does not occur in more than ½ or 1 per cent. of all cases of acute rheumatism; and the so-called 'rheumatic nephritis,' has probably no real existence. The frequency of albuminuria is not greater than can be accounted for by renal embolism, the probable existence of chronic cardiac and renal disease, the possible association of scarlatina, and the presence of pyrexia.

7. **Serous inflammations.**—Peritonitis is a very rare complication, described chiefly by French writers. Rheumatic 'orchitis,' or inflammation of the tunica vaginalis, is occasionally met with. Rheumatic pleurisy and meningitis have been already referred to.

8. **Gout.**—When acute rheumatism attacks a subject of the gouty diathesis, its symptoms may be considerably modified. The pain, swelling, and selection of particular joints have all a gouty character more or less; and whilst the disease is more amenable to treatment directed against the gout, it has possibly a greater tendency to lapse into a chronic affection of the smaller joints.

9. **Scarlatina.**—Scarlatina may make its appearance at any period during the course of acute rheumatism. The concurrence of the two diseases may occasionally be accidental; possibly they mutually predispose to each other, by lowering the general health and increasing the liability to chill; whilst some authorities hold that many of the ordinary complications of scarlatina, as well as the arthritis, are essentially rheumatic, such as serous inflammations and nephritis. The occurrence of rheumatism as a complication of scarlatina is discussed elsewhere. *See* SCARLET FEVER.

DIAGNOSIS.—Although acute rheumatism can generally be easily recognised, its diagnosis is sometimes a matter of the greatest difficulty.

In the stage of *invasion*, it is most readily confounded with the acute specific fevers, including influenza, and with catarrh, in which pyrexia and aching of the limbs are prominent symptoms. If sore-throat be comparatively well-marked, and the development of the joint-affection slow, the practitioner may be led to diagnose simple catarrh instead of rheumatism, and to make light of a complaint which is about to develop into a serious disease. In every doubtful case a certain number of facts should be kept clearly in view, namely, the history of the attack; the possible occurrence of previous attacks of rheumatism; the family history; the absence of symptoms characteristic of other diseases, such as eruptions or coryza; the development of pain or tenderness in a definite joint, and acid sweats; and most important of all, the discovery of the signs of inflammation of the heart.

In the second or *declared* stage, when one or more joints are involved, an entirely different group of diseases have to be diagnosed from rheumatism, namely, gout, 'rheumatic arthritis.'

gonorrhœal rheumatism, pyæmia, glanders, and acute synovitis or arthritis of traumatic or diathetic origin. In doubtful cases the characteristic phenomena of rheumatism must be kept clearly in mind, especially the transient and erratic course of the arthritic symptoms, and the probable presence of cardiac complications.

*Acute gout* may generally be diagnosed by the sudden invasion at night of a single joint—probably the great toe, in a man of middle or advanced age; by the severity of the pain, which is relieved by the occurrence of a characteristic swelling of the part; by the history of previous attacks of the same description; and by the insignificant amount of constitutional disturbance attending the arthritis. The discovery of uric acid in the blood will definitely settle the diagnosis of gout.

*Pyæmia* is usually associated with an injury or pre-existing surgical disease; and the fever has a markedly remittent character. Rigors are the rule, whilst they are the exception in rheumatism; the sweats are distinctly intermittent; the arthritis is neither transient nor migratory, but may advance to suppuration of the joints; and the symptoms of blood-poisoning and extensive and multiple visceral disease shortly supervene. Still it is a fact, which cannot be insisted upon too strongly, that cases of pyæmia are frequently mistaken at first for acute rheumatism.

*Gonorrhœal rheumatism* may be recognised by being persistent, whether one or more joints be involved; by the type and degree of the pyrexia; by the absence of cardiac complications, as a rule; by the presence of conjunctivitis; and, most certainly of all, by the existence of a urethral discharge.

*Rheumatic arthritis* may be distinguished by the characteristic deformity of the joints.

For the diagnosis of glanders *see* GLANDERS.

Ordinary *synovitis* is rarely multiple; is persistent and not migratory; and has an appreciable cause, whether traumatic or diathetic. *See* JOINTS, Diseases of.

The numerous difficulties which beset the diagnosis of sub-acute rheumatism, in children especially, have already been sufficiently dwelt upon.

PROGNOSIS.—In a disease which runs so uncertain a course, and which may be complicated by such a variety of dangers, the prognosis is necessarily most uncertain. The proportion of fatal cases, and of cardiac complications, and the average duration of an attack, can easily be stated; but in a given case there is at first no positive means of foretelling what course the disease will run in any one of these respects. The prognosis must be specially guarded in persons worn out by mental or physical overwork or anxiety; in young women of full flabby habit, with tendency to anæmia and disturbance of the uterus, stomach, and circulation; and in women after delivery—all subjects in whom cardiac inflammation and failure, and pulmonary complications are to be apprehended. Ill-declared, 'weak' symptoms, connected with the joints, indicating that the bodily strength and power of resistance are low, are less favourable than well-pronounced 'honest' pains and a warm sweating skin, which generally point to a favourable termination as regards life. It must, however, be observed that the risk of complications in some degree increases with the severity of the local symptoms. The probability of cardiac complications decidedly declines after the first week, but the possibility continues as long as fresh joints are being invaded. Rheumatism may be expected to run an exceedingly mild course in children, but the danger of cardiac complications is very great. In old subjects it may be safely assumed that the disease will end favourably. The supervention of pulmonary complications, especially in association with cardiac disease, or of hyperpyrexia, should cause anxiety, as immediately threatening life. Remote danger from acute rheumatism is chiefly to be estimated by the occurrence of heart-disease, and by the nature of the same.

TREATMENT.—The difficulties which beset an attempt to estimate the relative and absolute value of the different measures that have been proposed for the treatment of acute rheumatism, may be said to be at present insurmountable. Under the most favourable circumstances the number of carefully observed cases of any disease, subjected to a particular treatment, must be very large, before a safe conclusion can be drawn respecting the result. The most favourable circumstance for therapeutical observations is manifestly uniformity of the course of the morbid process. This condition is as much as possible wanting in the problem before us. Rheumatism is a disease of indefinite duration, of infinite degree of severity, and beset with a number of complications. It is not always possible to estimate the duration of the attack when the case first comes under observation. Lastly, many of the recorded cases have been treated by such complicated methods, that it is frequently quite impossible to eliminate the respective effects of the various drugs administered. In approaching the question of the therapeutics of acute rheumatism at the present time, these facts cannot be kept too clearly in view, for perhaps no disease has been alleged to have been successfully treated by so many different remedies.

1. **General treatment**—When called upon to treat a case of acute rheumatism, the practitioner must, in the first place, make certain special arrangements for the nursing of the patient. In addition to the ordinary measures proper in every case of an acute febrile disease which will probably prove of some duration, he must especially secure for the rheumatic patient perfect quiet, extreme gentleness of every necessary movement, and the prevention or relief of the discomfort attendant on constant and profuse perspirations. Next to a good strong nurse, and perfect hygienic arrangements of the sick-room, a proper bed is of the utmost importance in the general management of the case. The bed must be firm; standing on a firm floor; sufficiently narrow; and placed in such a position as to be readily accessible from either side, and allow the attendants to reach any part of the limbs or trunk of the patient, without interfering with the position and comfort of the other parts. Further, the bed must be 'made' as a 'rheumatic bed;' that is, a pair of blankets must be laced between the sheets—the one

over, the other under the patient, so as to absorb the profuse sweat, and diminish the risk of chill from dampness of the linen. The patient should be furnished with a long flannel bed-gown, made to fasten with tapes down the front and along the arms, so that the chest or any joint may be reached with the least possible disturbance. Arrangements must be made for collecting the urine and stools in bed; and the use of a urinal and a bed-pan, or a properly arranged towel for these purposes, is imperative.

These nursing arrangements being completed, the physician may turn his attention to the consideration of the therapeutics proper of the case. Two indications have to be fulfilled, namely, first, the relief of local symptoms which may be urgent; and, secondly, the reduction of the fever and the removal of the general distress. An effort must be made to secure these ends by separate measures, or by following some system that will effect both. The various measures at our disposal will now be considered, beginning with those which are at once the most simple, and the most urgently required.

2. **Local palliative treatment.**—*Rest.*—The most ready and satisfactory measure of a local kind for the relief of symptoms is the application of cotton-wool to the rheumatic joints. Cotton-wool is to be wrapped in some quantity around the parts, and secured by a moderately firm roller, or by a piece of warm flannel with the ends stitched together. The affected articulation is thus at once kept at rest and protected from cold and pressure; whilst uniform support is obtained. The relief obtained by this simple arrangement is often remarkable. The joints should be carefully sponged with warm water and soap, or warm water slightly alkalinized by carbonate of soda, before this or any other application; and the cotton-wool must be occasionally changed, especially if the perspirations be profuse. The principle of support and prevention of movement is more thoroughly carried out in a method of treatment which has found more favour with Continental than with English practitioners. This method consists in placing the joints in splints, as they become affected; in bandaging them firmly; or in encasing them in plaster of Paris. The results are said to be very satisfactory; the pain being reduced to a minimum, the fever falling, and the course of the disease essentially shortened.

*Anodynes.*—When the pain is severe, and relief is not to be obtained by simple rest and protection, anodynes may be applied to the rheumatic joints. Opium in any of its ordinary forms, belladonna and its allies, and other familiar anodynes, may severally answer best in particular instances. These substances may be applied on the surface of lint, secured and supported by a bandage; or the affected part may be lightly rubbed or smeared with the anodyne preparation in the form of liniment, and then wrapped in cotton-wool or flannel, as already described. Heat is generally grateful to acute rheumatic joints, but in many cases it is felt to be useless in the acute stage unless it be quite extreme. Thus simple warm fomentations may give relief; but the patient may urgently demand their constant renewal, so that they may be almost scalding. There are obvious objections to such a plan of treatment. Extreme cold has been recommended by some authorities, notably Professors Esmarch and Hueter, in the form of ice. It is seldom used in this country.

*Blisters.*—A favourite method of treatment with some physicians consists in the application of blisters to the rheumatic joints. The blisters, usually of cantharides, are intended to act less as counter-irritants than as 'derivatives' or 'evacuants.' Dr. Herbert Davies, who introduced the blister-treatment in this country, contends that the rheumatic poison is especially abundant in the neighbourhood of the joints, and is actually separated with the blister-serum, and so removed from the body. In its original and complete form, the blister-treatment consists in applying a strip of cantharides plaster near every affected joint at the height of the inflammatory stage. In some cases the amount of blistered surface may thus be enormous. The serum is encouraged to drain away, and the surface heals in due course. It has been claimed for the blister-treatment that it relieves the pain, shortens the course of the disease, and lessens the tendency to cardiac complications. Of the first effect, there is probably little doubt; the other effects are questionable; and statistics show that other methods of treatment are more efficacious in these respects. On the other hand, the danger of strangury, sloughing, and even pyæmia, and the substitution of another form of severe pain for that dispelled, must be mentioned as objections to its employment. For these and other reasons, a modification of the blister-treatment has been proposed, probably at the sacrifice of the principle, namely, local blistering when a stimulant is demanded, in cases attended with much depression; when the joint-symptoms are unusually severe; when other less severe means have failed; and when the condition threatens to become chronic.

*Leeches.*—The local abstraction of blood by means of leeches, whilst it relieves pain, is very rarely called for, unless the arthritis be so severe and persistent as to threaten to lead to suppuration.

*Electricity.*—It is said that, in some cases, marked relief follows galvanization of the rheumatic joints.

*Indirect anodynes.*—Certain lotions, of other than direct anodyne properties, have been recommended as local applications, to produce a specific effect upon the rheumatic joints, and thus indirectly afford relief. The chief of these are alkaline solutions, especially solutions of the carbonates of potash and soda, sopped into flannel wrapped around the joints. They may be combined with preparations of opium. Their value is somewhat doubtful.

3. **Medicinal treatment.**—(*a*) *Alkalies.*—Before the introduction of salicylic acid the alkalies were in general use in the treatment of acute rheumatism. The alkaline method consists in the internal administration of sufficiently large doses of certain alkaline salts, such as the carbonates, citrates, tartrates, and acetates, to render the urine quickly alkaline; in maintaining this reaction as long as the rheumatic symptoms

continue; and in gradually allowing a neutral or an acid reaction to return by diminishing the dose as the disease declines. It is claimed for this method that as the alkalies begin to exhibit their action on the system, the whole aspect of the case becomes more favourable, the general distress being alleviated, the temperature falling, and the local symptoms relieved; that these favourable effects continue to become more and more marked, until the rheumatic condition has disappeared; that the average duration of the attack is greatly shortened, not exceeding 6·75 days in the acute stage, and 13·5 days before the disappearance of pain; and that the proportion of complications is reduced as low as 2 per cent. only. In other words, it is asserted that in alkalies a direct antidote exists to the morbid influence (whatever that may be) which is the essence of rheumatism.

The *plan of administering* alkalies varies considerably. Some practitioners give large and frequently repeated doses, in order to obtain the speediest possible effect upon the system; whilst others give a moderate amount, or otherwise modify the exhibition of the salts. Of the two plans the first is unhesitatingly to be preferred. To obtain the full effect of potash upon the system, not less than half a drachm of the bicarbonate in an ounce of water should be prescribed at once, either alone or with citric acid in the effervescing form; and the dose is to be repeated every four hours. An equal amount of the acetate of potash may be added to each dose, if a still more rapid and powerful action of the alkalies be desired. The urine will probably become alkaline within twenty-four hours, and when once this effect has been obtained, it may very easily be kept up, by continuing the alkalies at longer intervals, which may be further increased as the symptoms decline. The effect of the drugs upon the patient must be carefully watched, and the amount and frequency of the dose varied accordingly, or its administration, if necessary, stopped. Finally, when the rheumatism is relieved, quinine may be added to the alkaline mixture; and as convalescence advances, the potash may be entirely withdrawn. Constipation occurring in the course of treatment may be relieved by combining the tartrate of potash and soda with the bicarbonate instead of the acetate, tartaric acid being used to cause effervescence; or if more obstinate, by a calomel and colocynth pill.

The alkaline influence upon the system may be further increased, in a very agreeable way, by supplying the ordinary effervescing potash or soda-water as a drink, either alone, or combined with milk, or with fresh lemon-juice. The patient may be encouraged to drink this in quantity, unless there be special indications to the contrary, such as cardiac distress. Should there be diarrhœa, lime-water may be substituted for the potash or soda-water. Should alkalies persistently cause purgation, their administration must be discontinued.

The *objections* that have been raised to the alkaline treatment are chiefly two: first, that it is useless—an objection which is not supported by statistics; and, secondly, that it is dangerous, an objection which only bears testimony to the power of the means employed, and suggests that the greatest care must be taken lest the exhibition of alkalies should be overdone.

(*b*) *Modified alkaline treatment.*—A modification of the preceding plan has been highly recommended by Dr. Garrod, and consists in the administration of quinine from the very first, in combination with large doses of alkalies; as much as five grains of the alkaloid (thus in the form of a carbonate) being given every four hours.

(*c*) *Symptomatic remedies.*—The most obvious general remedies for the relief of symptoms are *anodynes* and *apyretics*. So much benefit follows the use of opium in some cases, by relieving pain and diminishing nervous irritability, that it has acquired a reputation even as a specific. Although formerly given in large and frequent doses, such as a grain every three or eight hours, either alone or combined with mercury, opium is now seldom employed in acute rheumatism, except in the form of a moderate dose of Dover's powder, or of a morphia draught at night, to relieve pain and induce sleep. For these purposes it is employed by most practitioners, including those who adopt what they call the purely expectant method of treatment. The effect of the opium must be carefully watched, in the presence of the many complications which may possibly arise and contra-indicate its use.

*Apyretics.*—The vigorous employment of apyretic measures is unquestionably the method of treatment of acute rheumatism in greatest repute at present. It has been found that when the temperature is reduced by these means, the whole condition of the patient improves; the joint-symptoms decline; and the morbid process being apparently interrupted, the risk of cardiac complications is removed, at least for a time. Many apyretic remedies have been recommended, such as quinine, tartar emetic, veratrum viride, digitalis, aconite, mercury, and various diaphoretics. The use of quinine has been already referred to. At the present time reliance is chiefly placed upon two powerful remedies of this class, namely, the cold bath or the wet pack, and salicylic acid.

The *cold bath* is the most powerful and speedy method of reducing the temperature in acute rheumatism, but is seldom resorted to except in cases of hyperpyrexia. When this condition threatens, the cold bath or the wet pack is to be unhesitatingly employed, in the manner described elsewhere (*see* TEMPERATURE). If the symptoms be less urgent, cold sponging of the trunk may be sufficient to reduce the temperature.

The use of *salicylic acid*, the *salicylates*, and *salicin*, introduced by Dr. Maclagan, constitutes the present routine treatment of acute rheumatism; and the results obtained from it are certainly more favourable than from any other method. Fifteen to 25 grains of salicylate of soda, 20 grains of salicylic acid, or 15 grains of salicin, are given every one, two, three, or four hours, until the temperature falls to the normal, after which the dose of the drug is reduced, so as to be simply sufficient to maintain the apyrexia for several days. The salicylates are best given in watery solution, variously flavoured; salicylic acid in milk, or combined with liquor ammoniæ acetatis; and salicin in wafers, or in solution. Different practitioners prefer the different forms

of the active substance; the salicylate of soda is probably most extensively used, being readily dissolved, whilst salicin is less liable to excite unpleasant symptoms. These are deafness and noises in the ears, delirium, cardiac depression, sickness, and collapse. Short of these effects, the salicylates reduce the temperature to the normal in the course of twenty-four to forty-eight hours, relieve the pain and other arthritic symptoms, and markedly improve the condition of the patient generally; the duration of the disease, and perhaps the risk of cardiac complications being thereby diminished. The average duration of acute symptoms under the salicylates is about three or four days.

The principal drawback to the use of the salicylates is the fact that, whilst they cannot be continued for any length of time in sufficient doses to maintain apyrexia, without the risk of producing toxic symptoms, the rheumatism frequently returns as soon as their exhibition is stopped. Thus on the second or third day after the disease has been checked, the symptoms are again as severe as at first, and the risk of cardiac complications is again present. Whilst this objection is undoubtedly valid, it is still true that in a considerable proportion of cases no such relapse occurs, and that the patients are therefore virtually relieved or cured within forty-eight to sixty hours. If the salicylates fail or disagree, recourse must be had to alkaline treatment or to some other method. Certain practitioners combine the full alkaline method with the salicylates from the first; others prescribe the alkalies in diminished doses. Unfortunately anæmia appears to be more marked, and convalescence more slow, after treatment with salicylates.

*Hæmatinic* remedies may be considered to be indicated by the great anæmia which accompanies, and yet more markedly follows, an attack of acute rheumatism. Dr. Russell Reynolds has recommended perchloride of iron in large doses; and very favourable results have attended its administration, forty-three per cent. of all cases being convalescent in the first week.

*Alcoholic stimulants*, in moderate doses, are indicated in a large proportion of cases of acute rheumatism, when the symptoms are severe and protracted. Besides this routine use of alcohol, a special virtue is claimed for its free administration, as in other fevers, by the school of Todd and his disciples, in preserving the strength and relieving the pain. Brandy may certainly be freely administered with advantage in cases attended with extreme depression, even to the amount of 24 ozs. *per diem*, especially in the event of cardiac failure.

*Tonics* are indicated during convalescence; for example, quinine and iron, separately or combined either with alkalies or acids, and strychnia. Tonics should not be commenced too early.

(*d*) *Empirical remedies.—Lemon-juice* appears to have proved successful in some cases, in doses of eight ounces or less in twenty-four hours. Since the course of acute rheumatism is now known to be indefinite, the number of carefully recorded cases treated by lemon-juice is insufficient to permit a trustworthy inference to be drawn respecting its value. Similar doubts may be cast upon the alleged value of many other so-called remedies for the disease, such as *pyridine* and *trimethylamine*, in 4- to 8-minim doses every two hours; *nitrate of potash* to the amount of an ounce in the twenty-four hours; *cynara* or artichoke; and the *cyanides* of potassium and zinc. *Colchicum* was formerly given extensively in acute rheumatism, but has fallen into disrepute since this disease has been separated from gout. It may, however, be given with advantage for rheumatism in a gouty subject, to relieve pain. *Guaiacum* is useful in sub-acute lingering cases. *Bromide of potassium* has been found very useful in American practice, probably by relieving pain and restlessness. *Calomel*, in doses of 5 to 10 or even 20 grains, repeated for several nights, followed by saline purgatives in the morning, was highly recommended in some cases by the last generation of medical authorities, but cannot be said to be employed at the present day. The same remark applies to *venesection*.

4. **Expectant treatment.**—Reference must here be made to the observations of Sir William Gull and Dr. Sutton upon the course of acute rheumatism when treated by simple rest, and the exhibition of a *placebo*. The comfort of the patient is secured by ordinary means; and small doses of opium are given to complete this effect when indicated. The results have been remarkably favourable, but less so than those of several other methods of treatment, nine days being the average duration of acute symptoms, and the number of cardiac complications being very small.

5. **Treatment of complications.**—For an account of the treatment of the complications of acute rheumatism, the reader is referred to the respective articles on each of these in other parts of this work (*see* HEART, Inflammation of; LUNGS, Inflammation of; PERICARDIUM, Diseases of; &c.) The plan of treatment which is being pursued for the rheumatism may have to be temporarily suspended, or possibly completely changed, on the appearance of any of these complications. The treatment of hyperpyrexia is described in the article HYDROTHERAPEUTICS.

The state of the bowels requires the most careful attention. Constipation must be relieved by any of the ordinary means; and a purgative sometimes gives remarkable relief. Diarrhœa may be checked by lime-water or bismuth, or by a judicious dose of castor oil, according to its cause. The surface of the body must be regularly sponged with a very weak tepid solution of an alkaline carbonate.

6. **Diet.**—The proper diet in acute rheumatism is the same as that in most other kinds of fever. The patient must be fed at short and regular intervals, night and day, with the most digestible forms of nutritious food; and may be encouraged to drink milk, or milk and soda-water occasionally. It must not be forgotten, however, that in all probability the system is already overloaded with the products of imperfect assimilation and transformation; that the digestive system is weak and irritable; and that the heart may be seriously affected by the addition of much fluid or solid material to the blood. As the acute symptoms decline and appe-

tite returns, fish, milk-puddings, and shortly afterwards chicken, sweetbread, and other 'light' articles of diet may be allowed, and will be greatly relished. Meat must be strictly forbidden until every rheumatic symptom has disappeared. Thirst is best relieved in the acute stage, as already stated, by aërated alkaline waters, either alone or in combination with lemon-juice or milk, the quantity given being regulated by the practitioner, and accurately recorded.

7. **General after-treatment.**—The general management of a case of rheumatism after the decline of the acute symptoms is scarcely less important than at the commencement of the attack. The patient should be encouraged to keep his bed for several days after the disappearance of the joint-symptoms; and this advice becomes imperative when cardiac complications exist. Rest and comfort of body and mind must be secured at this period, for the purpose of quieting the action of the heart, and allowing the endocarditic process which affects the valves, and which probably outlasts the articular process, quietly to subside. All attempts must therefore be avoided at completing the cure of acute rheumatism within a certain small number of days. Even with these precautions the first day of sitting up generally proves an anxious time to the practitioner in cardiac cases. Locomotion must be forbidden for several days, and very gradually permitted. When the patient is able to move about and go into the open air, the danger of a relapse during the first weeks must be carefully kept in mind. Sudden and extreme changes of temperature are especially to be avoided; and for this purpose the patient must be warmly clad, and studiously avoid draughts and exposure to cold in other forms.

J. Mitchell Bruce.

**RHEUMATISM, Chronic.**—Synon.: Fr. *Rhumatisme articulaire chronique*; Ger. *Chronischer Rheumatismus.*

Definition.—A disease of the joints, of chronic course; referable to certain obscure influences of a diathetic and climatic nature; and characterised by various degrees of inflammatory and degenerative changes in the articular structures.

Ætiology.—The causes of chronic rheumatism, as far as they are known, are the same as those of the acute disease. The most powerful predisposing causes are inheritance, previous attacks of acute rheumatism, poverty, physical and mental depression, and laborious occupations entailing exposure to chills. For the last reason men are more liable to the disease than women. Chronic rheumatism is most common in middle life or advanced age, although by no means rare in young adults. Exacerbations of the symptoms are usually referable to exposure, and are accordingly most frequent or protracted in cold wet weather.

Anatomical Characters and Pathology.—A variety of anatomical changes may be met with in chronic rheumatism, whilst in the least severe form of the disease no definite changes in the articular structures can be discovered. In one variety recurrent hyperæmia and effusion are found in connection with the synovial structures, and with the articular and periarticular tissues generally. In the most severe cases the joints are enlarged and deformed, in consequence of anatomical changes which appear to be identical with those of rheumatic arthritis. *See* Rheumatic Arthritis.

This disease is truly rheumatic in its nature, being intimately associated with acute rheumatism. In many of the best marked cases the patient has previously suffered from the acute disease, either immediately before or more remotely; whilst in other instances one or more acute attacks occur in the course of the chronic disease. In yet another group of cases, a single member of a family will suffer from chronic rheumatism, ending in deformity, whilst his brothers and sisters are, without exception, attacked with the acute disease. The predisposing and exciting causes are also identical in acute and chronic rheumatism. Indeed, in every particular the two forms of affection run into each other, and are inseparably associated.

Symptoms.—The clinical characters of chronic rheumatism vary extremely in different instances. The leading symptoms of the disease are chiefly two, namely, pain and stiffness in connection with the joints and associated structures, recurring indefinitely for any length of time, aggravated by cold wet weather, and decidedly increased at night. More carefully investigated, the pains are found to have their seat in the joints, in the tissues of the limbs between the joints, or in both. Any or all of the articulations may be affected, but the site differs considerably in the different classes of the disease to be presently described. The pain is of a severe, aching, wearying character, attended with a sense of heaviness and uselessness of the limb; it is relieved by rubbing, and by exposure to a cold atmosphere; and is increased by slight warmth. Free use of the joint, although at first attended by much pain, often affords relief; whilst, on the other hand, severe exercise of the limbs during the day is liable to be followed by severe aching in the night. The affected joints also feel markedly dry and stiff, and creak on movement; but exercise or rubbing may also remove these sensations.

These symptoms may last indefinitely for years, either recurring at intervals, especially in the winter and spring seasons, or being persistent almost day and night without intermission.

Such are the essential characters of chronic rheumatism. Its other features are so variable as to permit of the formation of several well-defined classes or degrees of the disease, as follows:—

1. *First degree.*—In this class of chronic rheumatic cases the pain and stiffness just described are the only articular symptoms present. No apparent anatomical change is produced, either in the joints or in the associated parts. The subjects of this form of the disease may be otherwise well, vigorous, and long-lived, in spite of the severe pains by which their rest is broken in cold wet weather. They may or may not have, or have had, acute rheumatism.

2. *Second degree.*—In a more severe form of chronic rheumatism, the pain is associated with obvious anatomical changes; and the disease assumes the character of a recurrent subacute rheumatism, making its appearance at intervals

for years. The articular phenomena consist of redness, tenderness, and swelling, the hands being the favourite seat of the affection. These subacute attacks last for days; and leave behind them a distinct amount of swelling, which may not have completely disappeared before the next invasion. The process may thus, in course of time, lead to considerable enlargement, or even deformity of the joints.

3. *Third degree.*—Chronic rheumatism of the most marked degree generally occurs in persons who either have had, or may afterwards have, acute rheumatism; and is characterised by recurrent attacks of severe pain, tenderness, swelling, and hyperæmia of one or more joints, which lead to marked enlargement and deformity. A single joint may be affected at first; but the disease gradually invades the others, both large and small, until the whole articular system is involved. After some years the subacute attacks follow so closely upon each other, and their local effects are so marked, that the patient is never free from distressing pain; and the joints become anchylosed, dislocated, and otherwise disorganised. At the same time the general nutrition is gradually impaired; and the sufferer is anæmic, wasted, and debilitated. Chronic rheumatism of the most severe degree thus merges into, if it be not actually identical with, the class of disease known as 'rheumatoid' or 'rheumatic' arthritis. *See* Rheumatic Arthritis.

It is necessary to understand that the division just made of the leading varieties of chronic rheumatism into three groups, according to its degree, has been employed for the sake of description only. In a large number of instances the disease possesses certain characters both of the first and second degrees; whilst it is evident that cases belonging to the second degree may very readily advance into the third.

Course and Terminations.—The disease, as its name implies, is essentially chronic, generally lasting throughout the life of the individual whom it attacks, and leading to various conditions of debility and deformity, according to the degree of its intensity. In many instances the patient is rendered unfit for work; and such cases form a considerable proportion of the inmates of union infirmaries and other charitable institutions. Death as a direct result of the disease is rare.

Complications.—Cardiac disease is met with in a considerable number of cases belonging to the third or most severe degree of chronic rheumatism, being referable to endocarditis, which complicated the original acute attack. Dyspepsia and calculous disorders are not unfrequently seen in the subjects of the less severe forms.

Diagnosis.—If chronic rheumatism be regarded as a distinct disease from 'chronic rheumatic arthritis,' it is only in its most severe form that it can be confounded with the latter. A definite history of acute rheumatism; the presence of cardiac disease; and the non-involvement of such articulations as the jaw, the sterno-clavicular joint, and the spine, are considered to be features which render probable the diagnosis of true chronic rheumatism from rheumatic arthritis. But in the opinion of the writer, the two diseases are identical.

The pain, swelling, heaviness, weariness, and weakness associated with varix of the lower extremities, sometimes resemble closely the symptoms of the milder forms of chronic rheumatism. Physical examination at once removes all doubt.

Prognosis.—The prognosis of chronic rheumatism is favourable as regards life, but very unfavourable as regards cure; patients rarely losing the tendency to recurrence of pain throughout the whole of their life. Within a short time of the commencement of the disease it will be easy to discover which of the principal forms it is likely to assume; and the prognosis may be made accordingly.

Treatment.—The treatment of chronic rheumatism consists in (1) the relief of pain; and (2) the arrest of the rheumatic tendency, or the treatment of the disease proper.

1. *Palliative treatment.*—This chiefly consists in counter-irritation by iodine or cantharides; the application of anodynes, such as preparations of opium, belladonna, and chloroform; or friction with various stimulating liniments, containing camphor, soap, turpentine, or acetic acid. Regular warm fomentations night and morning, with very warm or even hot water, followed by rubbing and the application of a stimulating liniment under warm rollers, is one of the most efficacious methods of local treatment, the pains being prevented or relieved, and the stiffness removed often to a remarkable degree. Altogether, whatever view may be taken of the pathology of the disease, thorough local treatment of the joints and limbs will generally be attended with decided relief.

2. *General treatment.*—The most successful treatment of the condition of system with which chronic rheumatism is associated, is removal of the patient from the variable weather of England, to the warm and settled climate of sub-tropical or tropical countries. In the case of the poor this is, of course, impossible; and in them we have recourse to warmth of clothing and housing, as far as they can be secured, relief from muscular exertion, and the most nutritious and heat-producing diet that can be supplied, especially oils. To secure these necessary comforts, the chronic rheumatic poor have frequently to be admitted permanently into charitable institutions. Iron and cod-liver oil are the drugs best suited to support the general health. Courses of the mineral waters of Bath, Buxton, and Strathpeffer, in this country; and of many foreign baths such as Aix-les-Bains, Aix-la-Chapelle, Wiesbaden, Baden-Baden, and Hamman R'Irha, prove invaluable in many cases to those who can afford to try them. The ordinary Turkish bath may also afford temporary relief, if properly employed. *See* Rheumatic Arthritis.

J. Mitchell Bruce.

**RHEUMATISM, Gonorrhœal.**—Synon.: Fr. *Arthrite blennorrhagique*; Ger. *Tripperrheumatismus.*

Definition.—A form of inflammation of the joints and associated structures, the essential nature of which is unknown, occurring in the subjects of inflammatory discharge from the genito-urinary mucous membranes.

Ætiology.—This disease, as its name implies,

is generally referable to the presence of gonorrhœa. It may originate, however, in any kind of inflammatory discharge connected with the urethra, such as gouty or traumatic urethritis or gleet. It is much more common in men than in women, apparently on account of the comparative immunity from gonorrhœa of the female urethra; but, on the other hand, an affection of the joints which strongly resembles it, is found in connection with chronic uterine disease, or in the puerperal state. Either a rheumatic or a gouty history is frequently to be traced in the patient. Previous attacks powerfully predispose to the return of the disease on the recurrence of urethritis, even in a mild form.

Amongst exciting causes the most important appear to be injury of a joint, such as sprain; and chill during the course of gonorrhœa.

Persons who have suffered from the disease are frequently found to be, and to have been, peculiarly susceptible of urethral inflammation; excessive sexual intercourse being regularly followed by discharge in such individuals.

Anatomical Characters.—In recent cases of this disease the structures connected with one or more of the articulations are acutely inflamed. The cavity contains a variable amount of serous effusion, according to its form and size; the knee, for example, being considerably distended, whilst the digital joints are more moderately enlarged. The various component parts are hyperæmic and swollen; and the peri-articular structures full or even œdematous. In more advanced cases the joints are found to contain either sero-purulent or purulent materials; the cartilages may be eroded; and finally the articulations may become completely disorganised or anchylosed. The cardiac structures are not affected. The eye may present the ordinary appearances of catarrhal conjunctivitis.

Symptoms.—The disease, as ordinarily observed, commences at any period in the course of gonorrhœa—very frequently within a week of its appearance, but possibly not until it has degenerated into a slight gleet, or apparently disappeared. The patient is probably first aware of pain in the loins, or of swelling and pain in the soles of the feet, and very shortly these symptoms involve the ankles. In other instances the knees or wrist-joints suddenly become painful, tender, and swollen—possibly after strain or exertion. At the same time the patient is feverish, suffering from malaise and anorexia; the tongue becomes foul; and the pain, helplessness, gonorrhœa, and general illness give rise to restlessness and depression. Along with, perhaps even before, the articular symptoms, conjunctivitis sets in, affecting one or both eyes, and although of a well-marked catarrhal kind, usually passes off in a few days with little or no treatment.

The physical signs connected with the joints are generally well-marked, the parts being hyperæmic and much swollen, both from intra-articular effusion and from exudation around. The amount of œdema of the dorsum of the hand or foot when the neighbouring joints are involved by gonorrhœal rheumatism, and of the upper part of the subcutaneous surface of the tibia when the knee-joint is affected, is often remarkable. The severity of the pain varies much. At times it is great, preventing sleep, especially as it is usually aggravated at night; in other instances it is extremely slight, and the condition is then more chronic in character. The pain is 'gnawing' or 'aching;' according to some patients, it is more severe before the swelling appears, according to others it is aggravated by the swelling. An important feature of the pains in gonorrhœal rheumatism is that in some cases they are not limited to the joints, but involve the fibrous structures, especially the loins, the plantar and palmar fasciæ, the tendo Achillis, and the sheaths of nerves, such as the great sciatic. The muscles, or their aponeuroses, also appear to suffer; the fleshy parts of the arm, forearm, and thigh being occasionally complained of. Frequently indeed the patient declares that the pains are universal. Stiffness is also felt, particularly when a joint or limb has been kept long in one position. Tenderness varies much, like the other phenomena, being exquisite in some instances, and entirely absent in others. Portions of the tendon-sheaths may be found swollen and tender.

The heart and pericardium are very rarely, if ever, involved.

Such is the usual appearance presented by a case of gonorrhœal rheumatism within the first week of its appearance. Under favourable circumstances the symptoms may decline; but in the majority of instances one joint after another is invaded by the morbid process, whilst those already attacked either slowly recover or continue affected, the disease being thus protracted for several weeks or even months. Cases are met with in which all the joints of one or more limbs are simultaneously affected with gonorrhœal rheumatism, and have been so affected for ten or sixteen weeks; certain of the articulations being but recently invaded, whilst others are slowly recovering from the attack with which the disease commenced. In this manner every joint in the body may be invaded, including the jaw, the sterno-clavicular articulations, and the spinal column.

The class of case just described constitutes the most severe form of gonorrhœal rheumatism. Happily, in most instances the disease is much milder, only one or two joints being affected, and the process either ending with a sharp painful burst of acute synovitis, or, on the contrary, lapsing into a state of chronic intra-articular effusion, with neither tenderness nor pain.

When the disease is protracted, either in one or in many joints, the constitutional symptoms lose their acute character. There is little or no pyrexia; the appetite is fair; and the patient may even go about his work. But the health is gradually impaired, the patient being debilitated and depressed; in the most severe cases he may be completely crippled, and reduced to a condition of great helplessness and wretchedness.

Pathology.—Opinion is greatly divided upon the essential nature of gonorrhœal rheumatism. Three leading views may be mentioned. It is believed by some pathologists that 'gonorrhœal rheumatism' is nothing more than acute or subacute rheumatism, associated with gonorrhœa or other similar discharge. Other authorities recognise in the disease a mild form of pyæmia,

the source of infection being usually the urethra. The third view is perhaps not inconsistent with either of the other two. It represents gonorrhœal rheumatism as a trophic or nutritive disorder, due to reflex disturbance; the urethral inflammation affecting primarily certain centres in the spinal cord and brain, and the altered condition of these giving rise to the articular changes.

According to both the pyæmic and the trophic or reflex theory of gonorrhœal rheumatism, the joint-affection may originate in a purulent discharge from any mucous surface, the urethra included. Thus joint-disease has occasionally been observed in association with chronic uterine discharges, dysentery, and chronic bronchitis. It is beside the purpose of the present article to enter into a discussion of these theories.

Course, Duration, and Terminations.—The variable course of gonorrhœal rheumatism has been already sufficiently indicated. The duration of the disease is quite indefinite, varying from a few days to many months. The most unfavourable termination of the disease is anchylosis of the joints, with hopeless crippling; but this is rare. It never proves fatal directly.

Diagnosis.—The diagnosis of this disease turns upon the existence of an urethral discharge, in association with articular inflammation. The occurrence of the latter in young male subjects should always rouse the suspicions of the practitioner as to the presence of gonorrhœa; and he ought at once to ascertain, by careful inspection, the state of the urethra, never accepting the patient's statement on the subject. In some instances the history of a recent gonorrhœa may alone remain. The previous occurrence of one or more similar attacks in connection with gonorrhœa will confirm the diagnosis. Ophthalmia in association with subacute articular symptoms ought immediately to suggest the presence of gonorrhœal rheumatism.

Prognosis.—The prognosis is generally favourable. In young, healthy subjects, under careful treatment, the disease will probably shortly subside; whilst it will prove protracted and obstinate under the opposite circumstances. Gonorrhœal rheumatism increases in severity, and the prognosis is correspondingly more unfavourable, in subsequent attacks. Another point which should be seriously impressed upon the patient, by way of warning, is that the risk of the recurrence of arthritis also increases with each exposure to gonorrhœal infection.

Treatment. — The treatment of gonorrhœal rheumatism is still unsatisfactory. Whilst some practitioners endeavour to check the urethral inflammation as speedily as possible, others strive to encourage the discharge. The former plan appears to be the more rational and the more successful; and the treatment of the gonorrhœa should therefore be persevered with. The attention of the practitioner will, however, be directed chiefly to the joints. If the local symptoms be severe, absolute rest is necessary, the patient being confined to bed, and the affected limb protected by a splint in such a way that applications can be made to the joints. Anodynes may be called for at first, such as poultices, fomentations —simple or opiated, or a liniment composed of equal parts of extract of belladonna and glycerine. In other instances leeches may be tried; and blistering in others, where there is either great pain, unrelieved by anodynes, or persistent effusion. In subacute cases with little pain or general disturbance, strapping may be sufficient; and in a more chronic form of the disease friction of the joint and moderate exercise may effect a cure, for example, of the knee by walking.

Internal treatment must be pursued simultaneously. In acute cases free purgation should be obtained at first, and this should be followed by a course of alkaline salines, either alone or in combination with quinine. If the disease persist, iodide of potassium should be given, combined with alkalies or with iron, according to circumstances. In other cases mercurials effect a cure, especially if there be a syphilitic taint, which is not uncommonly the case. The diet must be carefully regulated in the different stages. In very chronic cases of gonorrhœal rheumatism, with threatening anchylosis, the patient should be sent if possible, to a warm watering-place, and be subjected to a thorough course of treatment both externally and internally. *See* Rheumatic Arthritis.

J. Mitchell Bruce.

**RHEUMATISM, Muscular.**—Synon.: Fr. *Rhumatisme musculaire*; Ger. *Muskelrheumatismus.*

Definition.—A disorder connected with fibro-muscular structures; generally associated with the rheumatic diathesis; and characterised by local pain and spasm, and a certain degree of fever.

Ætiology.—Muscular rheumatism is most frequently observed in the subjects of the rheumatic diathesis. It occurs in both sexes, and at all ages; children and adults being specially liable to rheumatic torticollis, and older subjects to lumbago and chronic muscular rheumatism of the limbs. The exciting causes are chiefly two; first, exposure to cold—above all, exposure of a muscular part to a 'draught' after exertion; and secondly, sprain or strain of the fibro-muscular structures. Muscular pain, tenderness, and spasms are also common in the invasion of acute rheumatism, and in gonorrhœal and chronic articular rheumatism.

Anatomical Characters.—Nothing is known respecting the anatomical characters of muscular rheumatism, if, indeed, there be any discoverable change in the muscular or fibrous structures.

Symptoms.—The disorder usually commences with slight febrile disturbance, possibly accompanied by sore-throat. Either simultaneously, or in children after one or two days, pain is experienced in the region of some definite muscle or muscular mass, such as the sterno-mastoid or the muscles of the loins; and this speedily becomes so severe as to constitute the leading symptom of the attack. The pain is present only when the affected muscle is thrown into action, so that it may be perfectly relieved by relaxation or rest of the parts involved. The slightest movement, however, from the position of relief is instantly attended with excruciating pain, of a peculiar spasmodic character, which persists until relaxation is again secured. The

constant effort to avoid pain gives rise to a feeling and appearance of stiffness, causing the patient to assume characteristic attitudes of the head, trunk, or limbs. Tenderness on grasping the muscle is occasionally well-marked. In some cases several of the joints may be affected with pain and stiffness.

The constitutional symptoms of muscular rheumatism are generally those of mild pyrexia. The tongue is furred; the appetite is impaired; the bowels are confined; the pulse is somewhat frequent, full, and soft; and there is a feeling of malaise. In other instances these symptoms are extremely slight or altogether wanting, the patient suffering from nothing more than local pain. Occasionally there is catarrhal ophthalmia.

Muscular rheumatism usually persists for several days, and gradually declines, but in the milder cases it may last for weeks. One form of the disorder is essentially chronic, the patient suffering for years from pain in various fibro-muscular structures, especially those of the shoulder, arm, thigh, and leg, during cold, wet weather.

Varieties.—The following local varieties of muscular rheumatism are recognised by special names:—

1. **Muscular torticollis.**—Synon.: Acute Wry-neck; 'Stiff-neck'; *Caput obstipum.*—Here the sterno-mastoid muscle is chiefly involved, but any or all of the cervical muscles may be painful. This form is most frequently observed in young subjects, and is often markedly recurrent. It is easily recognised by the fixed position of the head; and has to be diagnosed from spasmodic torticollis, sterno-mastoid tumour, sprain, and spinal disease.

2. **Pleurodynia.**—The fibro-muscular structures of the chest-wall are the seat of rheumatism in this variety. Cough is a common exciting cause of the complaint, which is seen chiefly in adults. Pain is complained of in the chest-wall, usually on one side; and in some instances it may be excruciating, and of a distressing spasmodic character. On examination it is found that a particular intercostal space, or the origin of the pectoral or serratus muscles, is the seat of localised tenderness; and that every respiratory act causes lancinating pain in the same situation. The respiratory movements of the affected side are restrained; but the ordinary physical signs of pleural, pulmonary, and cardiac disease are absent, as are also the *points douloureux*, which characterise intercostal neuralgia. If the movements of the corresponding ribs be restrained by plaster or bandage, the pain is effectually controlled. The direct constitutional disturbance is generally not great, unless sleep be prevented by pain.

3. **Lumbago.**—The muscular and fibrous structures of the loins are here the seat of pain, most commonly the erector spinæ, less commonly the latissimus dorsi, or other smaller muscles in the same situation, on one or both sides. As the muscles of the back support the body in the erect position, and participate in the various movements of bending the trunk in all directions, the patient may be compelled to remain at absolute rest in bed. More frequently he is able to go about, although with pain, or in a stooping attitude. The amount of febrile disturbance is generally moderate.

Lumbago is easily recognised by the characteristic muscular pain referred to the loins, greatly increased by bending, straightening the back, or by turning in bed; and by tenderness of the muscles on pinching, without acute defined tenderness on pressure, as in abscess or neuralgia. At the same time it cannot be insisted upon too strongly, that careful examination of the back, of the abdomen generally, and of the urine, will alone prevent the practitioner from falling into the not uncommon error of treating cases of serious disease for simple lumbago. Renal calculus, lumbar abscess connected with spinal caries, perinephritis, perityphlitis, abdominal aneurism, disease of the rectum, uterus, or bladder, and spinal meningitis, are the principal morbid conditions which must be borne in mind and excluded in every instance, before the diagnosis is settled. Pain in the loins is also a very common accompaniment of affections of the buttock and lower limbs, such as sciatica, rheumatic affections of the hip-joint, and perhaps lameness from any cause. It is also very frequently met with in gonorrhœal rheumatism.

4. **Cephalodynia.**—Muscular rheumatism may affect the scalp, giving rise to a dull, aching kind of headache, on the brow or occiput, aggravated by movement, and occasionally complicated with tenderness of the eyeballs and ophthalmia.

5. **Dorsodynia.**—Synon.: Omodynia; Scapulodynia.—These names are given to rheumatism involving the structures of the upper part of the back and shoulders. It occurs chiefly in persons much exposed to the weather; and has to be diagnosed chiefly from rheumatism of the shoulder-joint, and certain less common forms of neuralgia connected with the upper dorsal nerves and arms.

6. **Abdominal rheumatism.**—Muscular rheumatism of the abdominal walls is occasionally observed, either alone or in association with lumbago.

Diagnosis.—Speaking generally, muscular rheumatism has chiefly to be diagnosed from neuralgia, and, as a rule, this can easily be done by the paroxysmal character of the latter, the ætiological relations, and especially the physical signs. The practical diagnosis of the chief local varieties has already been sufficiently indicated.

Prognosis.—The prognosis of muscular rheumatism is highly favourable. Under careful treatment recovery may be anticipated in a few days or weeks. But the disorder is one which is peculiarly liable to recur on exposure to its exciting causes.

Treatment.—The treatment of muscular rheumatism consists in remedying the constitutional condition; and in relieving the local pain. At the very commencement of the illness, a hot air or Turkish bath may answer both these indications, and give immediate relief. The first indication will, however, be generally best fulfilled by free purgation, followed by alkaline salines, such as the bicarbonate, citrate, or acetate of potash, and acetate of ammonia. In more feeble subjects quinine may be given in combination with alka-

lies; and iodide of potassium in protracted cases. The diet should be of the simplest character.

The best local treatment consists of absolute rest of the affected parts, which may be variously secured in different instances by confinement to bed, by strapping, or by plasters. Counter-irritants or anodynes, applied locally, give great relief, and for this purpose either a hypodermic injection of morphia, mustard poultices, cupping, warm opiate fomentations, or various liniments composed of extract of belladonna and glycerine, opium, aconite, or chloroform and camphor, or of various combinations of these, may be ordered. Belladonna plaster gives at once relief and support in mild cases. The continuous galvanic current occasionally dispels the pain and stiffness almost immediately. The affected muscles must be kept warm and carefully protected from cold, especially in torticollis. When rheumatism involves the muscles of the limbs, warm anodyne liniments are the best local application.

Great care should be exercised to prevent the recurrence of muscular rheumatism, by wearing warm woollen clothing; by avoiding exposure to damp and draughts; by attending to the digestion and the bowels; and by abstaining from severe, sudden, and awkward muscular efforts. In chronic or recurrent cases of the disorder, the patient should, if possible, visit some of the English or foreign baths indicated in the article on Rheumatic Arthritis.

J. Mitchell Bruce.

**RHINOSCOPY** (*ῥὶν*, the nose, and *σκοπέω*, I examine).—Syn.: Fr. and Ger. *Rhinoscopie.* The practitioner is often called upon to explore the nasal cavities, either with the fingers or with instruments. In proceeding to see the interior of the fossæ, it must be borne in mind that the apertures of the nostrils descend lower than their bony floor; therefore, after having thrown back the patient's head, the nose should be elevated, and the nostrils dilated by means of dressing forceps. Owing to the narrowness of the fossæ digital examination is difficult, but a knowledge of their anatomy will facilitate the introduction of instruments; and the finger can be passed through the mouth and behind the velum pendulum palati, to explore the margins of the posterior nares, and the naso-pharyngeal cavity.

Rhinoscopy, or the optical examination of the choanæ, may be either anterior or posterior. Anterior rhinoscopy is simply and easily conducted by means of a speculum, either in the form of a small aural speculum; or, better still, by Thudichum's nasal dilator; and it will be found that reflected light, in most instances, answers better than direct sunlight. Posterior rhinoscopy must be employed to obtain a view of the deeper portions of the structures, and of the posterior aspect of the nares.

Instruments and Method.—The instruments used, and the method of examination, are the same as that in laryngoscopy (*see* Laryngoscope, The), excepting that the mouth-mirror is directed forwards and upwards, and placed beneath or behind the velum pendulum palati. By this means, not only the nasal passages are brought under observation, but the structures in immediate relation with them.

On proceeding to make a rhinoscopic examination, the patient should be directed to breathe through the nostrils while the mouth is open, so that the velum may be flaccid, and the introduction of the mirror facilitated. Some patients are unable to sustain this means of respiration, and in such cases, by causing the emission of nasal sounds, such as the French *en*, the velum is forced forwards and the palate drops. The velum may be pulled forward by means of forceps, but this operation is liable to cause spasmodic action of the palatal muscles, and it may take a long time before the parts become accustomed to the proceeding. It is almost always necessary to use a tongue depressor, as more room is obtained, both for observation and manipulation. The best form of hand mirror is the ordinary laryngoscopic one, with the glass set at an oblique, and not a right angle to the handle; and in using it, and looking at the reflection of the various structures at the back of the nares or vault of the pharynx, it must be remembered that only a perspective view can be obtained, owing to the position of the parts. The structures which come under observation by the use of the rhinoscopic mirror are—the posterior surface of the soft palate and uvula, the posterior and part of the lateral portions of the septum of the nose, the turbinated bones, the nasal meatuses, the pharyngeal walls of the Eustachian tube and its orifice, the vault or roof of the pharynx, the lateral walls of the pharynx, and the upper portion of the posterior wall of the pharynx.

The morbid conditions, for the inspection and treatment of which it may be requisite to use the rhinoscope, are described in the articles Nose, Diseases of; and Pharynx, Diseases of.

Edward Bellamy.

**RHONCHAL FREMITUS.**—A physical sign, appreciated by palpation of the chest, elicited by the act of breathing when certain secretions or other materials are present in the larger air-tubes or in a cavity. *See* Physical Examination.

**RHONCHUS** (*ῥέγχω*, I snore).—Rhonchi are sounds heard on auscultation when the air-channels are partially obstructed. The term is restricted by some authors to the so-called *dry* and more or less musical sounds produced in the bronchial tubes, for instance, *sonorous* and *sibilant* rhonchus; the bubbling and crepitating sounds in chest-disease being spoken of as *râles.* By other authorities, again, all such sounds, whether sibilant or crackling, are described either as *rhonchi* or as *râles*, the terms being interchangeable. *See* Physical Examination.

R. Douglas Powell.

**RHYTHM** (*ῥυθμὸς*, a measured movement). The relative proportion between the several parts of certain actions. In medical science it is generally applied to the movements of respiration, and to the action of the heart. *See* Physical Examination.

**RIBS, Diseases of.**—*See* Chest-walls, Diseases of.

**RICKETS** (A.-Saxon, *ricg*, the back). — Synon.: Rachitis; Fr. *Rhachitisme*; Ger. *Rhachitis*; *Englische Krankheit.*

Definition.—A general disease affecting the nutrition of the whole body; arresting natural growth and development; perverting and delaying ossification; retarding dentition; causing the bones to become soft, and to yield to pressure, and the muscles and ligaments to waste; and in many cases producing alteration of the brain, liver, spleen, and lymphatic glands.

Ætiology.—Rickets is the consequence of slow impairment of nutrition, and the causes which produce it are principally:—bad feeding, foul air, damp cold rooms, want of sunlight, want of exercise, and want of cleanliness. Of these, perhaps the first two have the greatest influence in causing the disease; for if the quantity of nutritive material introduced into the system be restricted by an improper selection of food, and if the oxidation of waste matters be hindered by an insufficient supply of fresh air, interference with nutrition is necessarily carried to a high degree. A pure bracing air will by itself do much in counteracting the effects of an improper dietary, for it has been noticed that injudicious feeding is less hurtful in country places where the air is dry than in large towns. This, however, may be partly explained by the greater vigour of the digestive organs in the former case, enabling the child to derive nourishment from food which, under other conditions, would be innutritious. Some children are affected more readily and more severely by these causes than are others, for the more the strength of the child is reduced before the actual exciting causes of the disease come into play, the more quickly does the patient fall a victim to their effects. Therefore, all influences which impair the general strength, such as weakness in the parents, or, in the case of the child himself, an attack of acute disease, or even unusually troublesome dentition, must be looked upon as predisposing causes of the disorder. There is no proof that rickets is hereditary. A tubercular family predisposition renders the occurrence of rickets unlikely. Recently a distinguished foreign physician has attempted, by arguments drawn chiefly from morbid anatomy, to prove rickets to be invariably a consequence of inherited syphilis. But the reasons for rejecting this hypothesis are overwhelming.

Anatomical Characters.—The bones are affected in three ways:—growth is retarded; the spread of ossification into parts still cartilaginous is interfered with; and bone already ossified is softened. The growth of bone is not completely arrested; it rather becomes irregular. There is considerable development of the cartilaginous epiphyses, and also of the fibrous periosteum; but these parts ossify incompletely and slowly; and as the normal increase in size of the medullary cavity continues in the usual way, the bone comes gradually to consist less and less of osseous substance, and more and more of, as yet, unossified matter proliferated at the circumference. It is in this way that the bones become soft, and not from any abnormal absorption of earthy salts from bone already ossified. The process of calcification itself, besides being retarded, is abnormal: it has indeed been described as rather a process of petrifaction than of true ossification. On account of the softness of the long bones, serious deformities ensue, as will be afterwards described. The flat bones become greatly thickened from proliferation of the periosteum. This is especially noticeable at the edges of the cranial bones; and when ossification is completed, the sutures of the skull can be felt to be prominent. In parts, however, and especially in the occipital bone, the osseous substance becomes thinned in places from absorption under the pressure of the growing brain. This condition, which is called 'craniotabes,' can be detected by palpation. Calcification is very slow in the cranial bones, and the fontanelle often remains open long after the end of the second year.

The liver, spleen, lymphatic glands, and kidneys are sometimes enlarged. The increase in size is due, not to the presence of any foreign growth or deposit in these organs, but to irregular hypertrophy of their fibroid and epithelial elements, conjoined with a deficiency in earthy salts —an alteration analogous to the changes in the bones. The brain is enlarged from an increase of the neuroglia, not of the nerve-elements. The voluntary muscles are small, pale, flabby, and soft. Under the microscope their striæ are seen to be indistinct. The urine contains less urea and uric acid than natural, but more phosphates, especially phosphate of lime.

Symptoms.—In most cases the symptoms proper to rickets are preceded by others which indicate a certain amount of interference with the digestive functions. There is occasional vomiting; the bowels are often relaxed; and the motions are habitually loose, pasty-looking, and offensive.

The beginning of the disease is marked by profuse sweating of the head, face, and neck; this is especially seen if the child fall asleep either at night or in the day. Almost at the same time he begins to throw off the bed-clothes at night. He will do this even in winter, and may be seen lying almost naked in the coldest weather. Later on, it is noticed that the child dislikes to be touched, and cries when danced about. He seems to be generally tender, and to dread movement of any kind. The occurrence of tenderness marks the commencement of the characteristic changes in the bones. The ends of the long bones enlarge; the flat bones become thickened; and all the bones lose their firmness and grow softer. These changes affect the osseous system as a whole, and lead to serious deformities. If the child had been able to walk, he becomes unsteady on his legs, or even loses the power of walking altogether. He sits or lies about; is drowsy in the daytime; and at night moves his head restlessly from side to side, so as in many cases to wear the hair off the occiput. The flesh is soft and flabby; the motions remain loose and offensive; and the child appears to be occasionally troubled with abdominal discomfort, for he may be found asleep in his cot, resting upon his hands and knees with his head buried in the pillow.

The softness of the bones causes them to yield readily to pressure, and it is to this cause, and not to the force of muscular action, as was at one time supposed, that the deformities are

chiefly due. The long bones become bent and twisted. The direction of the bending depends upon the direction in which the force of pressure is applied, and in the lower limbs will therefore vary according as to whether the child can or cannot walk. Sometimes, however, if the disease begins before the child is able to support himself upon his feet, the lower limbs may escape deformity altogether. They are usually in such cases particularly small and thin, with weak, flabby muscles, but the bones themselves are straight. Force of gravity is another cause of deformity of bone. Thus, in the humerus there is often a curve where the deltoid is inserted: this is produced in great measure by the weight of the hand and forearm when the limb is raised by the deltoid muscle.

The skull is elongated from before backwards; the fontanelle is wide; the sutures are thickened; the forehead is high, square, and sometimes prominent; and the head generally looks large. The face, on the contrary, appears small out of proportion to the head, for the growth of the facial bones is arrested. By palpation of the occiput the condition named 'craniotabes' can sometimes be detected. It is an early symptom. Dentition is much delayed, and the teeth when cut are deficient in dental enamel, so that they decay rapidly.

The spine is curved on account of muscular and ligamentous weakness; and if this weakness be great, the natural posterior curve of the spine is so much exaggerated as almost to simulate angular curvature. It disappears, however, at once when the child is lifted up by the shoulders. Sometimes the spine is curved laterally.

The deformity of the chest has the following characters:—The softened ribs sink in so as to present a groove passing downwards and outwards on each side of the sternum. The bottom of the groove is formed more by the ribs than the cartilages, so that the enlarged ends of the ribs, looking like a row of beads under the skin, can be seen lying along the outer side of the groove. The sternum is forced forwards by this bending of the ribs, and the antero-posterior diameter of the chest is increased. The deformity is due to the pressure of the external air. In healthy breathing this pressure is overcome by the resistance of the thoracic walls, aided by the force of the inspired air. In the rickety child the resistance offered by the softened ribs is greatly reduced, and they therefore sink in at the parts where they are least supported. On account of the softened state of his ribs, the breathing of a rickety child is quick and laborious.

The pelvis is pressed upon from above by the spine and the abdominal contents, from below by the heads of the thigh-bones; and the direction of these forces varies according to the position of the child. The general shape thus produced is triangular, and the pelvic cavity is often greatly narrowed.

A rickety child is short for his age; for his limbs, besides being bent, are stunted, growth in them being more or less arrested. His joints are large, and loose from relaxation of the ligaments. If the disease be severe, the child gets anæmic and wastes, and the muscles become very flabby and small. His belly is big, even when there is no splenic enlargement, from shallowness of pelvis and flatulent accumulation. Such children give little trouble. They are quiet, and seldom cry if left alone. They are late in walking, late in talking, cut their teeth late, and in nursery phraseology are 'backward children.'

Complications.—One of the chief characteristics of rickets is the intense sensitiveness to cold with which it is always accompanied; and it is to chills in different forms that a large proportion of deaths occurring in this disease must be attributed. A catarrh may affect the chest or the belly, and in either case the complication is a very dangerous one.

A pulmonary catarrh in a young child should never be made light of, on account of its tendency to cause collapse of the lung; and if the child be the subject of rickets, the danger is really imminent on account of the softness of the ribs.

If the chill affect the abdomen, as it is very apt to do, an intestinal catarrh is set up, and unless the diarrhœa be quickly arrested, the strength of the child becomes seriously reduced.

Besides its influence in increasing the susceptibility of the body to cold, rickets also heightens the nervous impressibility of the child. This effect is not a common result of mere weakness, for in an ordinary case of malnutrition with wasting, the natural sensitiveness of the nervous system to external impressions is impaired. It must be therefore looked upon as a peculiarity of the rickety state. Its effects are seen in the attacks of laryngismus stridulus and convulsions to which these children are so liable. Few cases of laryngismus occur in children who are not the subjects of rickets. Such patients usually have carpo-pedal contractions, and are liable to be convulsed upon the very slightest provocation. On account of the backwardness of the teeth in this disease, all nervous derangements are commonly attributed to dentition; but in rickets dentition, although delayed, is not necessarily troublesome; in fact the teeth, when they appear, are usually cut with singular ease.

Another complication often met with in rickets is chronic hydrocephalus: the excess of fluid is however small. This complication is often suspected where it does not really exist.

Diagnosis.—When the symptoms of rickets are well marked, the bony distortions themselves are sufficiently characteristic to make the nature of the disease unmistakeable. It is, however, of great importance to recognise the early symptoms of the disorder, so that by prompt treatment we may prevent the osseous and other changes taking place. It must be remembered that loss of flesh is a late symptom, and that a rickety child is not necessarily a thin one. If an infant pass the ninth month without any appearance of a tooth; if his wrists enlarge; and if on inquiry we find that he is subject to head-sweats at night, and likes to lie naked in his cot, the diagnosis of rickets may be made without hesitation. Weakness of the legs in a young child is often a source of anxiety to parents, and a medical practitioner is consulted because the child is twelve months old and cannot stand. In these cases the early signs of rickets will almost certainly be discovered. Looseness in the joints is common in cases of

rickets, where the symptoms of the disease manifest themselves at the end of the second year. The relaxation of the ligaments is not as a rule combined with much bone deformity, although it may be so. Weakness of the legs from rickets is distinguished from essential paralysis by the fact that, although there may be no power of standing, the child is yet able to move his limbs; and that the muscles, although weak, are not powerless.

Prognosis.—The duration of rickets is dependent upon the duration of the causes which produce it. So long as the baneful influences under which the disease originated are in operation, the morbid processes continue; but when a better hygiene is adopted, and failing nutrition is restored, recovery begins.

When recovery takes place, the symptoms gradually become less intense and finally disappear. The enlargement of the joints greatly diminishes, and even the bony distortions become notably reduced, while the bones themselves become thick and strong. Growth, however, is not rapid, and if the disease have been severe, the child seldom reaches the average height.

When the disease terminates fatally, it is usually through one of the complications which have been mentioned. Sometimes the child sinks and dies, apparently worn out by the intensity of the general disease; but even in these cases the immediate cause of death is usually asphyxia, through the softened state of the ribs. One cause of the great mortality from bronchitis in children is the frequency with which that complaint attacks rickety subjects, even a mild catarrh being seriously dangerous when the ribs are much softened.

In estimating the prospects of recovery in any particular case, we must pay attention to the amount of chest-distortion; and to the presence or absence of disease of the glandular system. If the ribs be much softened, there is always cause for anxiety; and if in a case of pulmonary catarrh there be great recession of the lower ribs in inspiration, the condition is a serious one. The presence of any complication, except perhaps chronic hydrocephalus, necessarily increases the gravity of the case.

Treatment.—As rickets is the direct result of mal-nutrition produced by the anti-hygienic conditions in which the child has been living, our first care must be to alter these conditions. We must see that the living rooms are thoroughly ventilated; that the child is taken out regularly into the open air; that he is warmly dressed; and that his skin is kept perfectly clean by the abundant use of soap and water. We must next select a diet for the patient which is at once sufficiently digestible and nutritious. The term 'digestible' as applied to diet is a relative term. Food digestible to one infant is indigestible to another, and food readily digested by a child in his natural state of health becomes indigestible to him when his stomach is temporarily weakened by teething or any febrile attack. It is not, however, sufficient that the diet should be digestible; it must also be nutritious. Children kept too long at the breast frequently become rickety even although fed at the same time upon other and suitable food; for the watery breast milk, which forms the principal part of their diet, is sufficient by its bulk to satisfy their desire for food, without supplying the required nourishment to the tissues. Rickety children at the breast should at once be weaned, and if under twelve months old, should be fed principally upon milk guarded with liquor calcis saccharatus, in the proportion of fifteen drops to the bottleful. They may take besides, broths, bread and butter, and occasionally the yolk of an egg lightly boiled or beaten up with milk. Instead of bread and butter, the milk may be thickened for some meals with Chapman's wheat flour baked in an oven; but farinaceous food should be given with very great caution to these children, on account of their tendency to acid indigestion, which renders a starchy diet particularly likely to disagree. Under twelve months of age the child can seldom bear more than one teaspoonful of a farinaceous powder twice in the day. After the first year, strong beef-gravy, and flower of broccoli stewed, may be added to the diet. At sixteen or eighteen months old, a little mutton may be given, carefully pounded in a warm mortar. A mealy potato well boiled and mashed may be allowed, but the effect of all farinaceous food is to be carefully watched. The presence of flatulent pains is a sure sign that the proper quantity has been exceeded.

The diet and general hygienic arrangements having been regulated, the secondary question of drug-giving has to be considered. Before adopting tonic treatment, it is important to improve the condition of the bowels. A dose of castor oil or of rhubarb and soda should be given to clear away undigested food, and afterwards a few grains of bicarbonate of soda with a drop of tincture of opium in a little aromatic water will soon remove the offensiveness of the motions. Citrate of iron may then be added to the mixture, and the child should begin at once to take cod-liver oil. The dose of the oil should be small at first (♏ xv—xx), and while it is being taken, the motions should be watched for any appearance of oil in the stools; if this occur, the dose is too large and must be diminished. As convalescence advances other medicines may be given; and iron wine, quinine, decoction of oak bark, reduced iron, and Parrish's food are all useful. So long as the previous directions have been attended to, the exact tonic used is of comparatively little moment; but cod-liver oil should never be omitted from the treatment. Lime has been strongly recommended by some authors, but according to the writer's experience is of little value unless combined with iron as in Parrish's food, in which case it is probably not to the lime that the benefit is to be attributed. It may once more be repeated that in rickets the success of treatment is in direct proportion to the conscientiousness with which the rules relative to diet and general management have been carried out; and the mother should be made to understand that the child's recovery depends upon her own watchfulness and care.

The bone deformities can be prevented to a certain extent, by hindering the child from walking while the bones are still soft. The bowing of the legs is often owing to the child's getting upon his feet before the bones have become

sufficiently consolidated to bear the weight of the body. In these cases light well-padded splints which project below the feet will be the best safeguard. When the ligaments of the joints are loose and weak, the joints may be much strengthened by a well-fitting silk elastic support.

After the tenderness of the body has subsided, the child should be well shampooed, especially along the spine, both morning and evening.

With regard to the complications: —diarrhœa and pulmonary catarrh must be treated upon ordinary principles. A good flannel bandage very much diminishes the tendency to relaxation of the bowels, and is of further value in retarding the too rapid descent of the diaphragm, and so in diminishing to a certain extent the recession of the chest-walls during inspiration. The nervous complications are best treated with bromide of ammonium or of potassium. Laryngismus stridulus is often cured at once by bathing the whole body three times a day with water of the temperature of 60° Fh.

EUSTACE SMITH.

**RIGIDITY** (*rigidus*, cold, frozen, stiff).—SYNON.: Fr. *Rigidité*; Ger. *Starrheit*.—This term implies the existence of a more or less fixed condition in parts that ought to be freely movable. It is a state met with principally in the limbs, where it is dependent upon certain unnatural conditions of the joints or of the muscles, either separately or in combination. It may, however, occur in the trunk as a whole, or in the neck, owing to the existence of tetanic or tonic spasms in muscles, due to one or other of various causes. The valves of the heart, and the arteries, when stiffened by fibrosis, are said to be rigid. Again it is a term commonly applied to a condition of the 'os uteri' during parturition, in certain women, in whom the orifice of the womb does not dilate co-ordinately with the increase in force of the uterine contractions. The term is also sometimes used in connection with the features. Marked rigidity of a limb at this or that joint often results from joint-disease. Perhaps more frequently, however, rigidity in a limb is primarily dependent upon altered functional or nutritive conditions of its muscles, which may or may not be associated with actual paralysis implicating the same parts.

Numerous cases exist in which, without the existence of paralysis, or with a comparatively small amount of it, tonic spasms occur in the muscles of a limb, so as to entail rigidity (*see* SPASM). This may be met with, for instance, in hysteria, and in the early stages of some spinal diseases, more especially in primary lateral sclerosis.

More frequently still, however, rigidity is found in association with distinct paralysis. For many years a distinction has been made between two kinds of rigidity associated with paralysis; the one of which, known as 'early rigidity,' is apt to supervene soon after the onset of a cerebral or spinal paralytic affection; whilst the other, known as 'late rigidity,' comes on rather in old cases in which mere paralysis with flaccidity of muscles may have been previously present. The former is now believed in many cases to have a tendency to pass into the latter form; and where this latter becomes well-developed, it is commonly associated with a secondary or with a primary sclerosis of the corresponding lateral column of the spinal cord, even though the initial paralysing lesion may be in some portion of the motor tract of the opposite cerebral hemisphere (*see* SPINAL CORD, Introduction to Diseases of). In early rigidity we have to do with mere functional changes in the muscles, and the condition itself of rigidity is not constant; it intermits from time to time during the day, and commonly disappears during sleep. But in late rigidity, associated with extensive secondary degenerations in the spinal cord, the nutrition of the nerves, as well as of the muscles and their tendons, appears to suffer, and that, for the most part, in an irretrievable manner. This more severe condition of rigidity is associated with actual shortening of muscles or tendons, and in this stage but little, if any, difference exists between the degree of rigidity of the limbs by night and by day. *See* MOTILITY, Disorders of.

H. CHARLTON BASTIAN.

**RIGOR.**—SYNON.: Shivering-fit; Fr. *Frisson*; Ger. *Frostanfall*.

SYMPTOMS.—This state is characterised by the following phenomena:—There is general shivering, the tremulous movements not infrequently being so great as to cause chattering of the teeth. The face wears an expression of great discomfort, or even of distress. The complexion, especially on the lips and beneath the nails, is blue and livid. The tongue is moist, although thirst is felt. The fingers are shrivelled and 'dead;' the skin dry and corrugated (*cutis anserina*); and the cutaneous sensibility diminished. The respiration is quickened and shallow. The pulse is frequent, small, and firm. The temperature of the general surface is raised, although a sensation of cold—sometimes of severe cold—often referred to the back or the abdomen, is present. The extremities, however, as the fingers, ears, and nose, may be colder than natural. With these may be combined other symptoms, such as headache, nausea, vomiting, and the special pains in the back or the limbs, which are proper to the different species of fever; but delirium is rarely present.

PATHOLOGY AND ÆTIOLOGY.—Rigors are the result of the disturbance of some, as yet undetermined, nervous tract, which, however, is clearly connected with, if not indeed the same as, the great co-ordinating centre in the medulla for the respiratory, cardiac, and vascular movements, and which must, further, be in intimate relation with the thermotaxic centre, if such exist. One of the exciting causes of this disturbance may be the existence of some abnormal differences between the temperature of the surface and that of the interior of the body. This suggestion of Liebermeister, at any rate, supplies an answer to one or two perplexing questions. It enables us to understand how it is that a man already in the grasp of a serious disorder, the temperature of whose body is raised, and is rapidly rising, has yet the same sensation of cold as a healthy man whose external temperature is below the normal, and whose nervous and vascular systems

are merely reacting in a perfectly natural manner under one of the commonest conditions of animal life, for in each case the surface is colder than the deeper parts, and thus gives rise to a sensation of cold. It gives a plausible solution of the paradox that the greater the absolute heat of the body as a whole, the more acute is the sensation of cold; and it establishes on a scientific basis the empirical belief in the value of rigors as marking the access of disease, when it is seen that their presence is a proof that increased tissue-change, as shown by the increased production of heat—the very essence of fever—has already begun.

The early diagnosis of fevers, whether idiopathic or symptomatic, is often greatly facilitated by the careful study of the phenomena of the initial rigors. Putting on one side the cases in which a local cause may be found to exist, very violent rigors occur chiefly in connection with the following diseases:—Malarial fevers, relapsing fever, variola, scarlatina, erysipelas, pyæmia, and croupous pneumonia. They are less marked in typhus and enteric fever, pleurisy, catarrhal pneumonia, and bronchitis. It must, however, be remembered that, in appraising the value of any nervous symptom, such as rigors, the personal factor is of extreme importance, and that general rules derived from averages are here more than ever misleading, if applied indiscriminately to individuals.

An additional argument for their central origin is found in the well-known fact, that in children and in persons of unstable nervous equilibrium —for example, epileptics—convulsions are a frequent result of the same causes which produce rigors in other cases.

Rigors occur under the following conditions:— 1. In health, when a more or less extensive part of the surface of the body is chilled by external cold. Indeed the chilling of even a very small extent of skin is sufficient to produce them. 2. From irritation of a sensory nerve, and especially in connection with some mucous surface. Thus rigors are an everyday result of the presence of irritating matters in the stomach or bowels, of catheterism, and of the passage of biliary or renal calculi. 3. With the access or the exacerbation of some local disease, especially if it be one which is to end in the formation of pus. Rigors occur, not only at the beginning, but also during the progress, and with great violence just before the bursting of an abscess. Thrombosis in veins is also attended by rigors. The writer himself once experienced very violent rigors in connection with extensive thrombosis of the veins of the left arm, due to a prick received at a *post-mortem* examination, although no suppuration whatever took place during the whole course of his illness. 4. At the beginning of idiopathic and symptomatic fevers, that is, when the fever has already begun, and the increased heat-production in the viscera has destroyed the natural balance between the temperature of the interior and of the surface of the body.

Although for practical purposes it is convenient to distinguish these different modes of origin of rigors, they are essentially identical; that is, in each we have the effect of irritation of a certain kind conveyed by afferent nerves to some central tract or organ.

Treatment. — Warm, mildly stimulating drinks and external warmth are always grateful to the patient, and perhaps shorten the duration of the attack. Tincture of aconite, in 5-minim doses, has the reputation of preventing the occurrence of rigors from local sources of irritation, and may perhaps be useful when they arise from more general or from constitutional causes. Nitrite of amyl also has been employed, apparently with some measure of success. But the only effectual treatment is that of the diseased condition with which they are associated, and this can rarely be begun with advantage before the termination of the rigors or 'cold stage.' Until that period has arrived it is at best useless to attempt any internal medication; even quinine is of little or no avail in this stage of malarial fever, and often seems merely to aggravate the sickness, headache, and general discomfort, which are the usual concomitants of rigors.

J. Andrew.

**RIGOR MORTIS** (Lat. The stiffness of death).—Synon.: Fr. *Rigidité cadavérique*; Ger. *Todtenstarre*.— The stiffening of the muscles after death, due to coagulation of their plasma. *See* Death, Signs of.

**RINGWORM.**—Synon.: Tinea; Fr. *Teigne*; Ger. *Ringwurm*.

Definition.—A disease of the hair-follicles and hair, of a circular figure, and spreading in the form of a ring.

Ætiology.—Ringworm is essentially a disease of the nutritive period of life; it is contagious, and sometimes communicated to the adult, particularly to women; in the latter case appearing on the unhairy parts of the body, such as the neck, the shoulders, the chest, and the arms. It is very generally taught and believed that the cause of tinea is the growth and development of a fungus-plant; that the disease is propagated by means of sporules, which are accidentally conveyed from one person to another; and that the subsequent folliculitis and other pathological processes result from the irritation caused by the parasitic fungus. That the disease does not become universal, instead of being sporadic, is explained by the admission that the spores require a favourable, that is, a morbid soil for their evolution and growth. The writer of this article entertains, however, a different opinion, and believes that the folliculitis is consequent on a depressed state of health of the individual; that the follicular epithelium is, therefore, imperfectly developed; and that the phytiform growth is a proliferation of the granular elements of the immature epithelial cells and of the hair-cells—a degeneration, in fact, of their component elements.

Description.—Ringworm of the scalp is recognised by loss of hair in one or numerous patches of a circular or oval figure, and of an average diameter of half an inch or an inch. The base of the patch is somewhat elevated; more or less papulated, from prominence of unhealthy follicles; coated with a furfuraceous desquamation; roughened by the stumps of hair broken at

different lengths; and sometimes covered with a matted stratum of withered and discoloured hair. There is rarely any redness or inflammation of the patches, their prominence being due to distension of the follicles with dry epithelial exuviæ, and accumulation of furfuraceous desquamation. Occasionally, however, the patch is bordered by an inflammatory ring, and the latter is sometimes surmounted with minute pustules. On the scalp it destroys the hair, which loses colour and texture, appears like tow, and breaks off close to the follicle. In chronic cases a peculiar scurfiness—'diffuse ringworm'—is the result. On the body it forms red, slightly raised rings, which may present a concentric arrangement.

Anatomical Characters.—A microscopic examination of the epithelium of the follicles and of the hair, detects in the substance of both a phytiform structure, which is identical in appearance with that of mucedinous fungi, consisting of mycelium and sporules, and growing and proliferating like a vegetable fungus (*see* Epiphyta); and this parasitic fungus has received the name of *trichophyton*. Hence, ringworm is regarded as a parasitic disease, and its contagion is supposed to reside in the sporules of the epiphyte, which, it is presumed, are communicated from one child to another by the agency of combs, brushes and the atmosphere itself.

The permeation of the shaft of the hairs by the trichophyton renders them brittle; they break off close to the aperture of the follicle; and when this occurs over the whole surface of the patch, the ragged stumps suggest the idea of having been eaten off by the grub of a tinea or moth. Hence the terms *tinea* and *ringworm* applied to the disease; the grub being presumed to devour the hairs from the centre towards the circumference, and so to give rise to the ring or circular figure of the patch. Looking to the scurfiness of the patches, Willan adopted the term *porrigo* for its designation; for example, *porrigo tonsurans* and *porrigo scutulata*; the latter from the shield-like figure of the patches. Its growth by the circumference, creeping as it were into the surrounding skin, suggested the term *herpes tonsurans*; and the discovery by Gruby of a fungus-structure commends the term *phytosis* as a generic title. A variety of ringworm is known as *kerion*. *See* Kerion.

Pathologically, tinea is a chronic folliculitis with some degree of infiltration of the skin; it is propagated from a centre to neighbouring follicles, and constitutes a thickened disk with thickened margin. On the scalp, where the follicles are large, the former prevails and the disease becomes chronic; whereas on the non-hairy skin, where the follicles are small, the inflammation subsides within the area, and travels onwards by the circumference. The folliculitis of ringworm rarely exceeds in pathological manifestation the production of a papule with congested and infiltrated base; but in certain constitutions it may give rise to a vesicle, and even to a pustule; the latter more particularly where the strumous diathesis prevails. The more pathognomonic characters of tinea are evinced by an excessive accumulation of laminæ of epithelium within the follicles, and by a disorganised condition of the hair; the epithelium as well as the hair being penetrated and filled with the mycelium and sporules of the trichophyte. In the shaft of the hair the trichophyte is seen in the form of stems branching from point to point, or rows of globular sporules; whilst the envelope of the hair is oftentimes composed exclusively of sporules.

Diagnosis.—The diagnosis of ringworm in its fully developed state is by no means difficult. The circular and oval disks, and stumps of broken hair, are pathognomonic of tinea of the scalp; whilst the circular, red, and elevated rings of tinea annulata on the non-hairy skin are equally so. Only two affections approach it in appearance, namely, dry eczema and area; but in eczema capitis, which is often furfuraceous, there are no stumps of broken hairs, the hairs being unaffected, and the disease is more chronic, or there may be a previous history of eczema, or evidence of its presence on other regions of the body. Alopecia areata or porrigo decalvans exhibits a total loss of hair on a smooth spot, with no other morbid affection of the skin than simple atrophy. *See also* Kerion.

Prognosis.—The prognosis of ringworm is twofold:—Is it contagious? Will it last long? To which we must answer that it is contagious wherever that state of health exists which is favourable to its development; and, secondly, that its duration will be governed by the age, as well as by the powers of constitution of the patient. It is very rarely met with in infancy and never in the adult; and, left to itself, it has a natural tendency towards cure. Nevertheless, it is sometimes prolonged for several years, and may interfere very seriously with the education of children afflicted with it; while, in general, it is kept up by defective hygienic conditions and unsuitable diet.

Treatment.—The treatment of ringworm must be *constitutional* as well as *local*: constitutional to improve assimilation and nutrition; and local to stimulate a feeble tissue to a more vigorous and healthy function. The constitutional remedies must consist of generous diet, fresh air, and exercise; ordinary tonics, and especially arsenic in nutritive doses—for example, two or three minims of liquor arsenicalis, or their equivalent of other arsenical preparations, with the meals, three times a day. The best local treatment is moderate friction with the iodide of sulphur ointment, diluted with two-thirds of benzoated lard, night and morning; daily brushing with the hair-brush; and no washing. Where the iodide of sulphur ointment proves irritating, the nitric oxide of mercury ointment, diluted in similar proportion, may be substituted. Tinea annulata of the body should be pencilled with the liniment of iodine daily, until the rings are arrested; and the same liniment may be applied to suspicious spots on the scalp, or as an additional stimulus to the scuta themselves.

The parasitic theory of the disease has led to the use of sulphurous acid and perchloride of mercury under the name of 'parasiticides'; but these remedies have no special advantage over those already named; and the corrosive sublimate is dangerous unless employed with great care.

In the French school, avulsion of the hairs, called 'epilation,' is the practice commonly

adopted; the process of tearing out the hair being followed by the use of a weak solution of corrosive sublimate. This practice brings to mind that terrible French remedy the pitch-cap, and is utterly unnecessary for cure. *See* Epiphytic Skin-Diseases; and Tinea.

Erasmus Wilson.

**RIPPOLDSAU, in the Black Forest, Germany.**—Mixed iron waters. *See* Mineral Waters.

**RISUS SARDONICUS or SARDONIUS** (*risus*, a laugh; and *sardonius*, connected with, or caused by, the herb *sardonia* or *sardoa*, that is, belonging to Sardinia).—A peculiar expression of the face, in which the features are distorted by spasm of the muscles, so as to present the appearance of a painful grin or laugh. It is usually observed in tetanus. *See* Tetanus.

**RODENT ULCER.**—Synon.: Fr. *Cancroïde*; Ger. *Epithelialkrebs*.—Rodent ulcer must be recognised as a kind of tumour; but its exact position amongst other forms of new growth is still not definitely decided. Hence, in this work a special article is devoted to its consideration. Most authors agree in classing it amongst the epitheliomas.

Clinical Characters.—*Naked-eye appearances.* A distinguishing feature of most rodent ulcers is the fact that ulceration follows *pari passu* with new growth, the result being that, as in the case of lupus, instead of the formation of a swelling or tumour, an actual diminution of the size of the part occurs. Another characteristic of the disease is, that while it often makes its appearance at a period of life which might be considered early for an epithelioma, it runs a course of extreme chronicity, and rarely, if ever, affects the lymphatic glands. Many cases last for twenty or thirty years, interfering but little with the general health, and at times in part undergoing a process of feeble cicatrization. Rodent ulcer begins as a pimple, usually on some part of the face, and most frequently on the side of the nose or about the eye. After remaining quiescent for a long time, perhaps years, ulceration occurs, and continues to spread with great slowness, involving in its course every structure that it meets. Thus in time huge caverns are excavated in the face; the eyeball may be destroyed; the nose and upper jaw may disappear; and, not unfrequently, if the disease reach the forehead, the dura mater is exposed, and the brain is seen pulsating at the bottom of the cavity. The appearance of the ulcer is characteristic: the surface is glistening, and is covered with very imperfect granulations; it has an uneven level, and is mottled with yellow and red; the margin is very slightly raised, and somewhat indurated, has a purplish pink colour, and is often considerably undermined. The discharge is thin and purulent. Capillary hæmorrhage not unfrequently occurs, but more severe bleeding is rare. A section through the edge shows the narrow margin of new growth, in which alone the characteristic structure is to be made out. Death may occur from old age or other causes independent of the disease; from an attack of erysipelas or meningitis, or from marasmus induced by the constant worry and discharge.

Microscopical Appearances.—Many tumours which approach somewhat nearly the condition above described will be found on examination to exhibit the structure of a lobular epithelioma (*see* Cancer); but the most typical ones will usually exhibit something like the appearance represented in fig. 119, facing p. 204. Beneath the epidermis, and imbedded in a varying amount of stroma, consisting of more or less well-developed fibrous tissue, are large, roundish, and irregular masses of densely-packed epithelial cells of small size, the circumferential ones taking an oval shape, while the deeper ones are circular. There is, as a rule, no tendency to the formation of globes; but, in some cases which have run a typical course, imperfect nests have been found; the so-called *prickle-cells* are, as far as the writer has observed, never seen. The cells are smaller than those usually seen in an epithelioma, and suggest the origin of the growth from the sweat-glands, a view which is favoured by the fact that the epithelial masses occasionally assume a more or less distinctly tubular arrangement. Strenuous advocates are found in support of, and in opposition to this theory of the primary source of rodent ulcer, and the same may be said of other hypotheses, such as that it starts from the hair-follicles or the sebaceous glands; but, in default of stronger evidence than is at present forthcoming, it would be unwise to dogmatise upon the question. The reader will find some of the literature of the subject in the late Mr. Charles H. Moore's book on rodent cancer, in Dr. J. Collins Warren's monograph on rodent ulcer, and in the various communications to the *Pathological Transactions*; but in German writings he must search under the head of Epithelial Cancer, to which class rodent ulcer has always been consigned.

Prognosis.—The prognosis in a case of rodent ulcer may be implied from what has been said of its clinical features.

Treatment.—The obvious treatment is free removal by the knife in the early stages. Mr. Moore was a strong supporter of the plan of removing even very large ulcers; he was in the habit of proceeding with the knife as far as prudence would allow, and applying chloride of zinc paste to any parts it was considered unsafe to remove. This treatment in his hands and in that of others has been followed by very marked success.

R. J. Godlee.

**ROISDORF, in Germany.**—Mixed alkaline table waters. *See* Mineral Waters.

**ROME, Central Italy.**—Moderately warm, moist, fairly calm, sedative winter climate. Mean temperature, winter, 46·75° Fahr. Prevailing winds, S.E. and N. *See* Climate, Treatment of Disease by.

**ROSALIA** (*rosa*, a rose).—A rose-coloured rash; a term formerly applied to scarlatina and rubeola, before these rashes were clearly differentiated.

**ROSEOLA** (*rosa*, a rose).—Synon.: Fr. *Roséole*, Ger. *Roseola*.—This affection, the name

of which is derived from its crimson tint of colour, is one of the exanthemata or rashes of the skin, and in common parlance is called 'rose-rash.' In general characters it resembles a mild form of measles, and has consequently received the name of 'false measles.'

ÆTIOLOGY.—The cause of this exanthem is feverish excitement, resulting from heat and exhaustion; hence it is frequently epidemic in hot weather. Although allied in appearance with measles, it cannot be regarded as contagious. Frequently it is symptomatic.

DESCRIPTION.—Roseola ordinarily assumes the form of a punctated rash, more or less suffused, but it sometimes occurs in small erythematous blotches, which spread by the circumference and form rings. In the latter cases it is only distinguishable from erythema by its roseate colour.

The exanthem forms part of a slight febrile attack, attended with weariness, lassitude, nausea, and prostration; and is accompanied with more or less redness of the fauces, and sometimes with swelling and tenderness of the submaxillary glands and occasionally of the neighbouring lymphatic glands. The exanthem has a course of four or five days or a week, and then disappears, leaving the patient convalescent; and, like its congeners the exanthemata, it begins with the head, then travels downwards to the trunk of the body, and is last perceivable on the arms and legs. It is rarely of sufficient force to be followed by exfoliation of the epidermis.

VARIETIES. — Besides those objective terms which liken roseola to measles, it has likewise been called after the seasons when it commonly occurs, *R. æstiva* and *R. autumnalis*. Other terms, such as *R. punctata*, *corymbosa*, *maculosa*, *orbicularis*, *annulata*, and *papulata* relate to varieties of its pathological characters. An exanthem, identical in appearance with idiopathic roseola, is met with in secondary syphilis; the punctated rash which is associated with continued fever is likewise a roseola; whilst other forms, which have been observed associated with variola, vaccinia, gout, rheumatism, and cholera, may be regarded as erythemata resulting from venous hyperæmia.

DIAGNOSIS.—The diagnosis of roseola has been sufficiently illustrated by the above description—a punctated rash, corymboid like measles, but sometimes orbicular or annulate like erythema; its special pathognomonic characteristic being its crimson or rose colour.

PROGNOSIS.—The prognosis of roseola is favourable; the feverish disturbance subsides in a few days or a week. The prognosis of symptomatic cases necessarily varies.

TREATMENT.—Rest and repose together form an important element in the treatment of roseola. A mild purge may be necessary to regulate the digestive organs, and may be accompanied with effervescent salines. Locally, the skin should be anointed with some soothing and un-irritating oily substance, such as vaseline, olive oil, or benzoated lard. ERASMUS WILSON.

**ROSE-RASH.**—A popular name for roseola. *See* ROSEOLA.

**RÖTHELN.**—The German synonym for rubella; frequently employed by English practitioners. *See* RUBELLA.

**ROUND-WORMS.**—In respect of their form the various species of nematoid entozoa more or less resemble earthworms, and, consequently, are collectively called *round-worms*; but the term is by many persons restricted to the large lumbricoid parasites which infest man and several of the lower animals.

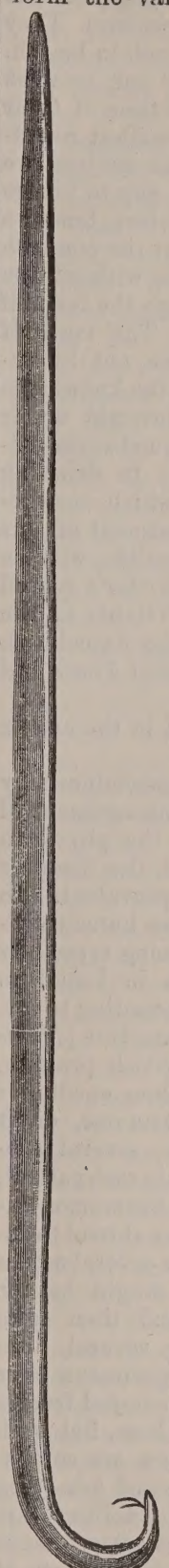

FIG. 71.—*Ascaris lumbricoides*; male, with exserted spicules. Nat. size (original).

DESCRIPTION.—The human round-worm (*Ascaris lumbricoides*) varies much in size, the males measuring from four to seven inches in length, and the females usually from nine to fourteen inches, though an instance has been recorded from America where a female measured seventeen inches. The general structure of the worm was long ago investigated by Cloquet, Owen, Dujardin, Busk, and others; but the most modern and important additions to our knowledge of its anatomy are due to the writings of Eberth, Bastian, Schneider, and Leuckart. In the matter of development, the writings and labours of Nelson, Thomson, Kölliker, Meissner, Richter, Davaine, and Heller are particularly noteworthy. The precise manner in which the essential act of fertilisation is accomplished in nematoids carries with it no practical issue, but experiments with the mature ova have an important bearing on questions of sanitation and infection. Verloren, Vix, and others have reared intra-chorional embryos of various nematode species in water; and the writer himself has watched the development of the eggs of *Ascaris lumbricoides*, in fresh water, through all the stages of yelk-segmentation up to the stage of an imperfectly organised, coiled embryo, subsequently keeping the ova alive in this condition for a period of three months. Dr. Davaine pushed the facts of development much further. He kept the ova alive for upwards of five years. He administered some of these five-year-old embryos to rats, and had the satisfaction of finding a few of the eggs in the rodents' fæces, with their contained embryos still alive, but striving to escape the shells. As a general result it may be said that the embryos escaped their shells; but only in the case of those eggs whose contents had arrived at an early embryonal stage of growth, did the gastric juice of the experimental animals act upon the shells, and thus liberate the contents of the ova.

Of yet more practical importance are the observations of Heller, respecting a *post-mortem* 'find' made in May, 1872. In the small intestines of a lunatic he discovered eighteen specimens of very young round-worms; all of them being referable to the species in question (*A. lumbricoides*). They severally measured from $\frac{1}{3}$ to $\frac{1}{2}$ an inch in length. Now, as Heller himself has pointed out, between the embryos as they appear at the time of their expulsion from the egg and the smallest round-worms hitherto seen in the human subject, we have, as regards size, an immense gap to bridge over. This 'find' of Heller's, therefore, tends to make it appear almost certain that the common round-worm completes its life-cycle without the necessity of having to pass through the body of any intermediary animal bearer. The truth of this conclusion, moreover, is borne out by numerous facts, which have come to the knowledge of the writer. In one instance brought under his notice, a local endemic of roundworm-helminthiasis was clearly traceable to drinking water from a filthy stream, into which sewage-deposits flowed. The further treatment of this subject, in reference to public health, will be found more fully discussed in the writer's second memoir 'On the Dispersion and Vitality of the Germs of Entozoa,' read before the Association of Medical Officers of Health (*Medical Times and Gazette*, 1871, p. 215).

The *Ascaris mystax* is described in the article Ascarides.

Symptoms.—The symptoms superinduced by round-worms, and the practical management of cases, more immediately concern the physician and practitioner; but in England, the disorder is, speaking relatively, not very prevalent. In some countries round-worms in the human subject are extremely frequent, this being especially the case in tropical regions, as in India, in China, in Central America, and, according to Dr. Dyce, still more notably in the Mauritius (*Medical Gazette*, 1834). Whilst, in British practice, we seldom encounter more than one, or, it may be, several specimens in each patient, it is no uncommon experience abroad to encounter several scores in a single bearer. Now and then from one to several hundred specimens have been removed from a single host, but such instances are comparatively rare in England. Marshy and low-lying grounds, in the neighbourhood of dwellings, are eminently productive of round-worms, hence their comparative abundance in some parts of Holland, and in the lake-districts of Sweden. Dr. Brandt, of Oporto, informs the writer that lumbricoids are very common in Portugal, affecting something like 75 per cent. of the children, who frequently pass large numbers by the mouth as well as by the anus.

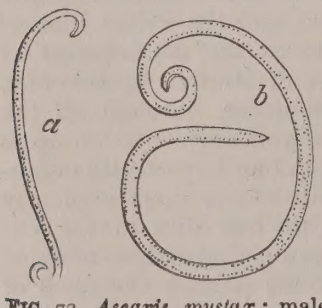


Fig. 72. *Ascaris mystax*; male (*a*), and female (*b*). Natural size. After Leuckart.

Many remarkable phenomena result from the presence of these large worms in the human subject. Ordinarily, the symptoms bear a close resemblance to those arising from thread-worms, but the results are commonly of a graver character. As stated in the writer's published lectures (*Worms*, p. 113), they give rise to colicky and shooting pains about the abdomen, followed generally by more or less dyspepsia, and accompanied with nasal itching, nausea, vomiting, and even diarrhœa. Sometimes, also, there is cerebral disturbance, attended with general restlessness and convulsive twitchings during sleep. In severe cases, amaurosis, catalepsy, convulsions, erotomania, and death by enteritis or by perforation of the intestine, have been known to occur. These worms have a remarkable tendency to grope about the intestinal canal, as if seeking a new abode, and thus it is that they not unfrequently make their way into various and, so to speak, unsuitable parts of the body, where they cannot thrive. Amongst other strange situations, they have not unfrequently been found in the gall-duct, in the cavity of the thorax, and especially in the parietes of the abdomen. This habit of wandering often proves fatal to them. Any foreign solid body in the intestine, with a suitable hole in it, is sure to attract their attention, and to form a sort of worm-trap. Thus these parasites have been strangled by metallic buttons, by 'hooks and eyes,' by an open-topped thimble, and by other miscellaneous foreign bodies accidentally or purposely swallowed by their human bearers.

Numerous cases, many of them fatal, have appeared in journals during the last half-century. The writer's treatises on *Entozoa* (1864) and *Parasites* (1879), as well as Davaine's *Traité* (1877), abound with references of this kind, and since these books were published other notable cases have been placed on record. Amongst fatal instances occurring in this country, the cases by Blair (*Edinburgh Medical Journal*, 1861) and Rogers (*Lancet*, 1848) deserve mention. An interesting example of perforation and consequent abdominal abscess, followed by successful treatment, was also recorded by Sheppard (*British Medical Journal*, 1861). A case very similar to this has been orally communicated to the writer by Dr. Reginald Pierson, of Leipzig, the patient, a soldier, having come under his care during the Franco-German war.

Children appear to be more liable to harbour large numbers of these worms than grown persons. Küchenmeister refers to a case where a child passed 103 worms, and to a second instance where another child was infested by upwards of 300; whilst, in Gilli's yet more striking case the child voided no less than 510 worms (*Giorn. d. Sci. Med. di Torino*, 1843). In a case communicated to the writer by Dr. Mackeith, of Sandhurst, Kent, the patient, a child of only five years, passed upwards of 300 worms, most of them having been expelled in consequence of appropriate treatment with santonine and aloetic mixtures. One of the specimens measured 15 inches in length. The sympathetic nervous symptoms are often most serious. Hysteria, catalepsy, chorea, epileptiform seizures, paralysis, loss of sight, deafness, mental defects, eclamptic fits, convulsions, maniacal excitement, and other obscurer phenomena, have

been recorded as due to the presence of these worms. That these affections have in most instances been exclusively due to the presence of the parasites, is proved by the fact of the frequent and immediate disappearance of the symptoms following the expulsion of the worms. The writer is indebted to Dr. H. Cooper Rose for particulars of a case, in which a child only fifteen months old suffered from severe convulsions, the symptoms entirely disappearing after the expulsion of upwards of a score of these lumbricoids. Cases of the most violent delirium, and even of complete idiocy, have entirely recovered upon the employment of suitable vermifuges; whilst in instances where the presence of the worms has either been overlooked or disregarded, a fatal result has ensued. In the standard work by Davaine, numerous instructive references, with particulars of the cases, are fully recorded; whilst the writer's introductory work supplies many others. In this connection, also, an interesting and instructive paper by Assist.-Surg. G. D. D. Goopta appeared in the *Indian Medical Gazette*, and *London Medical Record*, 1874. From observations made at the dispensary at Tangail, he concludes that lumbricoid worms may be an exciting cause of suicide. Such deaths are more common among the Mussulmans than the Hindoos. Round-worms were found by Goopta in twelve out of eighteen bodies of suicidal hanging, that is, in about 67 per cent. The greater number of those who committed suicide were of the age at which the worm is frequent. When, by reflex action, the worms bring on irritation, the sufferers turn peevish and low-spirited, and can scarcely withstand any trifling reprimand or correction. To them these insignificant causes become so painful, that they immediately resolve to relieve themselves by suicide, the hanging-method being generally adopted.

Diagnosis.—The diagnosis of round-worm is usually a very simple matter, because the patient is sure sooner or later to pass one or more parasites, even though he or she may not have taken medicine. In cases where only one worm exists its presence is rarely suspected, and in those instances where the existence of these worms is overlooked, although many happen to be present, it often turns out that they are lodged in the stomach instead of occupying their more usual seat, namely, the small intestines. In all obscure cases of dyspepsia and the like, especially if there be colic, it is well for the practitioner to make a microscopic examination of the fæces. In cases of chronic vomiting, especially if there be hæmatemesis, the contents of the stomach should be carefully scrutinised, for in this way, as the writer himself has found, the ova of the lumbricoids may be detected, and the true nature of the case will at once become apparent. On the other hand, the practitioner should exercise the greatest caution lest he give encouragement to the notion of parasitism (so often erroneously entertained by hypochondriacal subjects), without fully going into the history and other particulars of any given case.

Treatment.—When once we are satisfied as to the presence of round-worms, their expulsion is necessary, and, fortunately, not very difficult of execution. Of the many vermifuges recommended, none are equal to santonine, which in the case of children may be administered in the form of powder, in doses of two to four grains, mixed with sugar and sprinkled on bread and butter, and followed by a saline cathartic, or a large spoonful of castor-oil. Many prefer to mix the crystalline powder with the oil itself, or to combine it with two or three grains of the resin of scammony. The plan of giving the drug over night, followed by a morning cathartic, is objectionable to some extent, since it leaves abundance of time for the santonine to exert its physiological action, which is not the purpose intended. For adults from five to ten or even fifteen grains are often employed on the Continent; but the writer has seen evil effects from the larger doses, and considers it imprudent to administer more than five grains once a day for three days in succession, combined with castor-oil. If larger doses are given the effects should be carefully watched, as this drug has been known to produce tenesmus, spasms, and even hæmorrhage. The writer has several times noticed giddiness, with more or less mental confusion, as the result of moderate dosing with santonine. In all cases it is as well to tell the patient that vision is apt to become temporarily impaired; and that the daylight, as well as all objects looked at, may appear yellow, or, in rarer cases, blue or green. The urine almost always acquires a deep yellow or red tinge, which is alone sufficient to alarm some patients. Fortunately these physiological phenomena quickly disappear. Perhaps, as regards the employment of santonine, it is as well, in the case of young persons, to follow the advice of Küchenmeister, who remarked that we 'should never administer more than eight grains in two days, divided into doses of two grains each twice a day.'

Amongst the various other remedies employed, aloes, scammony, jalap, calomel, sulphur, and turpentine hold a prominent place; but their utility as vermifuges is for the most part due rather to their drastic properties than to any specific action on the worms themselves. As a lumbricifuge, no remedy is equal to santonine, which, however, may be combined with, or followed by, any one of the above-mentioned drugs with advantage. If santonine and turpentine be employed, they should be combined with castor-oil. Dr. Pockles, of Holzminden, recommends the powdered root of male fern in conjunction with ordinary purgatives; whilst kamala and kousso are spoken of favourably by others. In doses of from one to two drachms, the kamala powder has proved effectual in the hands of Drs. Mackinnon, Ramskill, and Leared. The South African fern-powder, or 'payna,' so much employed by the Kaffirs for tape-worm, has also been recommended; but its lumbricifuge virtues are probably inferior to those of kousso and male fern, which latter drugs ought, in the writer's opinion, to be employed only in cases of tænia. According to Davaine, the so-called 'varec,' or Corsican moss, which is procured from various species of sea-weed, is much employed in France, but the results obtained are variable, probably owing to adulteration. Dr. E. J. Waring speaks favourably of several Indian remedies. Thus the *zet-zi*

or *theet-tsee*, the black varnish of the Burmese, is said to be a most efficacious lumbricifuge, and the Burmese also employ a fungus, or worm-mushroom, called *thanmo*, which, according to Dr. Packman, has considerable anthelmintic power. The inhabitants of Java, and the Chinese living at Macao, employ a worm-fruit termed cây-tlum, obtained from the plant *quisqualis indica*. There is also a small annual, *vernonia anthelmintica*, extensively distributed throughout Hindostan, the seeds of which, according to Waring, are held in the highest repute amongst the people of Southern India. Many other drugs having drastic and anthelmintic properties are employed in Eastern countries; but of all the various remedies none is so satisfactory as santonine, combined with or followed by purgatives, and continued for several days in succession. *See* ASCARIDES; and LUMBRICUS.

T. S. COBBOLD.

**ROYAT**, in France.—Muriated alkaline waters. *See* MINERAL WATERS.

**RUBBING SOUND.**—A synonym for friction-sound. *See* PHYSICAL EXAMINATION.

**RUBEFACIENTS** (*ruber*, red, and *facio*, I make).—A class of counter-irritants which produce simple redness of the skin. *See* COUNTER-IRRITANTS.

**RUBELLA** (dim. of *Rubeola*).— SYNON.: *Rubeola sine catarrho*; False Measles; German Measles; Epidemic Roseola; Fr. *Rougeole*; Ger. *Rötheln*.

DEFINITION.—A specific eruptive fever, the rash appearing during the first day of the illness, beginning on the face in rose-red spots, extending next day to the body and limbs, subsiding with the fever on the third day, and not preceded by catarrh or followed by desquamation.

ÆTIOLOGY.—Propagated by contagion, rubella occurs in epidemics, often of limited extent, but with sporadic offshoots. It has a long period of incubation, mostly a fortnight, the extremes being from six to twenty-one days. Hence a difficulty in tracing the source of personal infection; this is increased by the slight and transient nature of the illness allowing patients to mix freely with others. One attack is preventive of a recurrence, but is not protective against either measles or scarlet-fever, nor do attacks of either of these diseases in any way modify the liability to this one; it is as distinct from them as is chicken-pox from small-pox. During epidemics of measles or of scarlet-fever mild and irregular cases of both are not unfrequently mistaken for this exanthem; well-marked outbreaks of it are often attributed to measles, while slight attacks of scarlet-fever are miscalled rötheln, and a hybrid disease imagined which has no existence. Very young infants seem less susceptible than older children; a child at the breast has been known to escape when the mother and other children in the family have been attacked. Adults not unfrequently suffer, as many persons escape attacks in childhood; sex makes no difference. The disease is contagious, even before the rash is thrown out, and it continues to be so for some days, or it may be weeks afterwards. Second attacks are rarer than in scarlet-fever, but the rule against them may be less absolute than for measles. Rötheln is seldom fatal; when a mortality is reported as high as 3 per cent. of the attacks, measles is present.

SYMPTOMS.—Slight fulness of head, heaviness, pain, or giddiness is felt, with aching of the back or limbs, and a little tenderness of the throat, for twelve hours or a day before the rash appears. Very often the rash is first seen with surprise, as the feeling of illness has passed or may have escaped notice. Some enlargement of the lymphatic glands in the neck is an early sign, most marked in children. There is redness of the fauces and uvula, less mottled than in measles, not so intense as in scarlet fever; the tonsils are full and smooth; there is no ulceration. Sometimes an odour, as in measles, attends the rash. The eyes are suffused, but there is little or no coryza; the lids are somewhat swollen and irritable; the face is flushed, and the cheeks are red or full before the appearance of the spots. These are bright red, raised, rounded, with clear skin between them, but they soon coalesce; not grouped as in measles, the spots are more prominent than in scarlet-fever, and there is not the finely-diffused redness of the neck and chest observed in that disease. Moreover, the rash is already fading from the face and upper part of the body while extending to the limbs, so that it is less intense on the third day. It leaves some itching, or a very fleeting yellowish tinge, but no discoloured mottling of the skin, and no desquamation. However little illness is felt at the beginning, a continuous rise of temperature commences with, or just before the rash; it may reach 102°–3°, or be only 2° Fahr. above the normal; with rest in bed this may fall one degree by the end of the second day, but is evenly maintained as the eruption proceeds, and subsides with it on the third day. During the following week it is readily disturbed, either raised by exertion or depressed by fatigue or chill. At this time recrudescence of the rash has been observed.

Slight catarrhal signs not unfrequently come on after the rash has faded, the eyelids are sticky, the nostrils stuffed, the throat sore, or some cough begins. Exposure, or want of care at this time may determine serious disturbance of health, generally with pulmonary complication.

The urine is often high-coloured in the early part of the illness, the chlorides are increased, but there is no albuminuria, nor has this ever been known to follow. In some few cases transient complaint of the throat or of fatigue has been made a week before the rash, or epistaxis has occurred; fulness of the small cervical glands is often felt, but no constant intermediate symptoms are found, and any feeling of sickness is without fever.

DIAGNOSIS.—The sudden onset of this form of rubeola without previous sneezing or cough distinguishes it from measles, to which it is much more nearly allied, as well by general characters as by the kind of rash, than to scarlet-fever; but the spots are more evenly distributed at wider intervals, each with an areola of its own before coalescence, and not in groups with a common areola; there is no gradual rise of temperature

before the rash, nor the sudden fall afterwards, both characteristic of measles. The small lymphatic glands in this ailment are palpably enlarged down the sides of the neck, and perhaps behind the ears, but not specially at the angle of the jaw, as in scarlet-fever. The rash on the second day may look like that of scarlet-fever, or the red flush of scarlet-fever at first sparsely distributed, or with prominent red papillæ, may lead to mistake; but the sudden onset is much more marked in scarlet-fever when, should the rash appear as early, yet it is more intense on the third day, especially on the neck and chest; moreover, the fever persists till the fifth day, even when not greatly elevated; there is also the state of the pulse and tongue, and the prominence of throat-symptoms. Sometimes it is not till the second or third week that the kind of desquamation, and possibly signs of renal irritation, or the occurrence of other cases, complete the diagnosis. The length of interval between successive cases is also a distinction. Roseola is not contagious; it occurs in red points or spots, not raised above the healthy skin between; there are no throat-symptoms, no enlarged lymphatic glands, or fever. Erythema affects parts of the skin only: attention restricted to the character of the eruption often leads to error.

Pathology.—As in most infectious diseases, particles given off from the sick, chiefly by the breath, attach themselves to the mucous surface of the throat or air-passages, and either multiply themselves, or produce a morbid change in the material around them; this morbid matter entering the lymphatics is at first arrested in their glands, and thence enters the blood. For a time some of this may be deposited again at the point from which it started, or the amount be too small to produce that arrest of nerve-tone which permits the dilated vessels and increased combustion of general fever. A special effect on the vaso-motor nerves of the skin is necessary to produce the turgidity of the rash, and this not of the momentary character of a passing irritation. Local irritation of the sympathetic in the neck, starting from the mucous membrane, may determine the early appearance of the rash on the face. The skin generally has not the intense vascular injection, with the exudation that results in detached epidermis, as seen in scarlet-fever, nor do the congested vessels of the papillæ leave such dilated meshes as after measles. Whether any special microzyme is associated with rubella there is no histological research to show.

Prognosis.—Recovery is so much the rule, that were it not for the mischief any febrile disturbance may excite in weakly children, and the risk of pulmonary disease from premature exposure, all cases of rubella might be expected to do well. In severe cases the throat must be looked to, and in all cases the chest examined. We must bear in mind that infection persists for a month, and that two months may elapse before health is quite restored.

Treatment.—Rest in bed for three days, and confinement to the house for a week, is almost all that is required; the fever demands no secretion to be increased for its mitigation, nor any special means for its control. Dilute acids may be given for relaxed throat; and tonics, such as bark or iron, during convalescence.

William Squire.

**RUBEOLA.**—A synonym for measles. *See* Measles.

**RUMINATION** (*rumino*, I chew again.)—Synon.: Fr. *Rumination*; Ger. *Wiederkauen.*—Rumination, which is the normal method of digestion in a large class of animals, occurs occasionally in the human subject. In the cases recorded the return of the food usually took place about a quarter of an hour after the meal had been finished. The regurgitation seems to have been produced by the contractions of the muscular coat of the stomach, assisted by those of the diaphragm and abdominal muscles. The food is usually stated to have had no acid taste, and therefore could not have undergone any digestion. Dr. Copland recommends that the meals should be deliberately and carefully masticated. As to medicinal treatment, he had found benefit from ipecacuanha and aloes twice a day, and a tonic draught one hour before dinner. Samuel Fenwick.

**RUPIA** (*ῥύπος*, dirt or filth).—Synon.: Fr. and Ger. *Rupia.*—A term applied to the crusts formed by the desiccation of purulent and ichorous discharge, over the foul sores or ulcers of syphilis and lupus.

Description.—The crusts of *syphilitic* rupia vary in thickness and extent. Sometimes they are flat and rugged, and sometimes prominent; and they are generally marked on the surface by concentric lines, which indicate the peripheral growth of the ulcers which they conceal. Their colour is grey, sometimes brown, and more or less mottled with black, from admixture of blood with the purulent secretion. When of large size and flat they suggest the idea of an oyster-shell imbedded in the skin; at other times they are conical in shape, like the shell of the limpet. This latter variety results from the desiccation of the discharges poured out by a pustule in course of centrifugal growth, and the consequent superaddition of fresh layers to the under surface of the original crust.

Rupial crusts found in *lupus* are harder, and never so large as those of syphilis. They differ also in pathological structure, being concretions of epidermal substance, instead of mere desiccated masses of morbid secretions.

Treatment.— The treatment of these two forms of affection is that of the diseases which they separately represent, namely, syphilis and struma. Syphilitic rupia is chronic syphilis in a state of ulceration, and calls for the treatment applicable to that disease. Iodide of potassium will heal the ulcerations, and then the crusts of rupia will fall off of themselves. It is better to avoid removing them artificially, as they constitute a natural covering to the ulcers whilst the latter remain in existence.

Erasmus Wilson.

**RUPTURES** (*rumpo*, I break).—Synon.: Fr. *Ruptures*; Ger. *Risse.*—The subject of rupture of organs generally has been thoroughly discussed in the article Perforations and Ruptures.

to which the reader is referred; and the consideration of this lesion in connection with particular organs is fully entered upon where this is required, as in the case of the heart, stomach, and other important viscera. The general meaning of the word is so evident that it needs no definition. In addition to its obvious meaning, the word is used in a popular sense as a synonym for hernia, which is spoken of as *a rupture*. *See* HERNIA.

FREDERICK T. ROBERTS.

# S

**SACCHORRHŒA** (σάκχαρον, sugar, and ῥέω, I flow).—A term applied to the escape of sugar from the body in any of the excretions or in discharges, such as the urine, sweat, or expectoration. *See* DIABETES MELLITUS.

**ST. ANTHONY'S FIRE.** — A popular synonym for erysipelas. *See* ERYSIPELAS.

**ST. GALMIER, in Loire, France.**—A simple acidulated table-water. *See* MINERAL WATERS.

**ST. MORITZ, in Upper Engadine, Switzerland.**—A cool, bracing, mountain climate. Mixed chalybeate springs. Altitude, 6,000 feet. *See* CLIMATE, Treatment of Disease by; and MINERAL WATERS.

**ST. SAUVEUR, in the French Pyrenees.** Sulphur Waters. *See* MINERAL WATERS.

**ST. VITUS'S DANCE.**–A popular synonym for chorea. *See* CHOREA.

**SALIVARY GLANDS, Diseases of.**—SYNON.: Fr. *Maladies des glandes salivaires*; Ger. *Krankheiten der Speicheldrüsen.*

SUMMARY.—These glands, as well as their ducts, are liable to be attacked by inflammation; the latter may also become mechanically occluded. The parotid gland is the seat of the disorder known by the name of *Cynanche parotidea*, or Mumps (*see* MUMPS). *Salivary calculus* and *salivary fistula*, as well as *ranula*, are described in the article MOUTH, Diseases of. Occasionally the parotid is sympathetically invaded by inflammation during the height of, or at the termination of, other acute diseases, and this affection requires special consideration here.

**Metastatic or symptomatic Parotitis.**—This affection is met with during the course of, or convalescence from, several of the acute eruptive fevers, such as typhus, enteric fever, scarlatina, small-pox, or measles. It commences, according to the researches of Virchow, with congestion of the gland, followed by the usual result. Soon thereafter the duct becomes affected; and there is found in it a tough, filamentous, whitish substance, which speedily is transformed into pus. This invades the lobules of the gland; these then soften and break down, until the whole of the gland-tissue is more or less destroyed, as well as the interstitial tissue, by phlegmonous inflammation. Sometimes, however, only the gland-tissue proper is destroyed, and the gland, when examined *post mortem*, appears as if studded with numerous suppurating islands. This phlegmonous inflammation spreads from its seat of origin in various directions, most frequently to the neighbouring connective tissue enveloping the muscles found in this situation, descending even to the clavicle, not even sparing the periosteum and bones; and it has even been known to pass to the brain and its coverings.

SYMPTOMS. — If this affection develop itself during the height of an acute disease, then, by reason of the stupifying effect of the primary disease, the more manifest subjective symptoms are wanting, and the complaint is consequently said, somewhat improperly, to come on insidiously. But careful observation will reveal, by the unusual rise in temperature, the increased restlessness, and the somewhat distressed look of the patient, that some new complication is about to discover itself, and will warn the intelligent practitioner to make a close physical examination of the various organs. Probably the first indication of this metastatic parotitis will be a little swelling about the lobe of the ear, and closer investigation will show loss of the usual depression between the lower jaw and the mastoid process, and in its place a more or less hard tumour. Pressure will usually elicit an expression of pain from the apathetic patient. The inflammation may end either in resolution or in suppuration. The former termination may be looked for if the enlargement have formed slowly, and during the convalescence of the individual from the original disease. Suppuration is, in all cases, to be dreaded; and this is indicated by the irregularly reddened appearance of the swelling, and ultimately the sense of fluctuation. Occasionally the pus finds its way outwards, or discharges through the external auditory meatus, this latter being by no means an uncommon method of exit; or the pus burrows about in the cellular tissue investing the various muscles in this region.

PROGNOSIS.—This depends greatly on the severity of, and the stage of, the primary disease during which this complication declares itself. If it make its appearance at the height of the fever, and particularly if that be a grave form of fever, then the prognosis must be very guarded. Trousseau remarks that it is an affection from which he has almost never seen enteric or other fever patients recover. This is certainly not in accord with the experience of this country. If it

occur during convalescence from a fever or other disease, the prognosis is then much more favourable.

Treatment.—Warm poultices must be applied from the first; supporting measures used; and the patient's powers sustained by plentiful nourishment, and the exhibition of stimulants and tonics. If there be any tendency to suppuration, the poulticing must be diligently maintained, and an opening made into the abscess the moment that fluctuation is sensibly made out. Caution must be exercised in this case, for if no pus be evacuated, the incision not only is useless, but rather increases the œdema of the tissues, besides putting the already weakened patient to unnecessary pain.

**Enlargement of the Parotid Gland.**—This may be either benign or malignant. In the former case it is usually the result of a previous parotitis, or it may be due to the development of some tumour in the body of the gland. Such cases are distinguished from the malignant variety by the skin always remaining freely movable over the tumour, and over the lower jaw; while in the malignant affection the lower jaw is with difficulty defined, and is not readily moved. The tumour is always limited to one side; and the malignant growth never has its starting point in this gland, similar disease being found in other organs. The simple tumour may be modified, if not altogether removed, by the external and internal use of iodine long continued; failing this, surgical operation is called for. The malignant variety is incurable. Claud Muirhead.

**SALIVATION.**— Synon.: Ptyalism; Fr. *Salivation*; Ger. *Speichelfluss.*—Increased flow of saliva can only be styled a disease when the amount secreted exceeds that which in health passes into the stomach. Strictly speaking, ptyalism is not a distinct disease, any more than dropsy can be so accounted, but it obtains a position as an independent disorder in the nomenclature of diseases, and must therefore be shortly noticed.

Ætiology.—The causes which give rise to salivation are numerous, as are also the diseases of which it is a symptom. Thus any irritation of the mucous membrane of the mouth and fauces at once induces an increased flow of saliva. Hence this is one of the leading symptoms of aphthæ, thrush, cancrum oris, ulcers, and excoriations of the mouth and tongue, scorbutic and syphilitic affections of the mouth, glossitis, mumps, and various affections of the fauces and pharynx. This salivation may also be a reflex effect, as when it occurs in cases of tic, facial neuralgia, pregnancy, or gastric affections. Ptyalism is also the result of the ingestion of certain drugs, mineral and vegetable, as in the case of the prolonged use of mercury and iodine. These seem to produce an alteration in the character of the saliva, as well as in the quantity. An increased or diminished flow of saliva is also induced by direct nervous agency, as when mental emotions, such as fear, suddenly render the mouth parched and dry; and the opposite effect is induced by the thought of palatable articles of food, and then the mouth is said to 'water.' In various conditions the saliva dribbles away, as in the insane, in paralytic persons, in those stupified by disease, such as typhus, and in teething children.

Symptoms.—The symptoms of salivation are evident enough. The individual complains of no pain, but of the exceeding discomfort in the constant spitting and gathering of saliva in the mouth, which interrupts speech, deglutition, and sleep. If it continue unchecked for some time the patient emaciates. When the affection is due to mercury, the first evidence of the constitutional action of the drug, which precedes the salivation, is a peculiar taste in the mouth, of a 'coppery' nature, with tenderness of the gums of the upper jaw, and fœtid odour of the breath; then there are observed salivation, large flabby tongue, and if it goes still farther, ulceration of the gums and mouth.

Treatment.—When salivation is due to some nervous cause, or if the cause be not very apparent, ten-drop doses of tincture of belladonna thrice daily are often sufficient to put an end to it in one or two days. If it be induced by mercury or other drug, the use of this must be entirely suspended. Mild astringent mouth-washes should be ordered, such as chlorate of potash, alum, or acetate of lead in solution, to be used frequently. Claud Muirhead.

**SALZBRUNN, in German Silesia.**—Alkaline waters. *See* Mineral Waters.

**SALZKAMMERGUT, in Austria.**—An inland bracing summer climate. *See* Climate, Treatment of Disease by; and Ischl.

**SAND-WORM.** — A term sometimes employed to designate the sand-flea or jigger. *See* Chigoe.

**SANGUINE TEMPERAMENT.** *See* Temperament.

**SANGUINEOUS** (*sanguis*, blood).—This word is used in relation to the presence of blood in discharges, effusions, or extravasations, when they consist more or less of this fluid, as in hæmoptysis, hæmorrhagic pleurisy, and cerebral hæmorrhage.

**SANITARY** (*sanitas*, health).—Relating to health; a term generally used in connection with laws, measures, &c., bearing on health. *See* Personal Health; and Public Health.

**SAN REMO, Western Italian Riviera.** A mild, sheltered, equable, moderately dry, and calm winter climate. Mean temp. winter, 48·5°. Exposed to E. winds. Soil, clay. *See* Climate, Treatment of Disease by.

**SARATOGA, in New York, United States.** Alkaline chalybeate waters, containing traces of iodine and bromine. The springs of Ballston, a few miles from Saratoga, are of a like character. *See* Mineral Waters.

**SARCINA** (*sarcina*, a pack or bundle).—A genus of microscopic fungi, belonging to the order Saccharomycetes of the lowest division of the vegetable kingdom, *Protophyta*, and of occasional occurrence in the human body, where they were first discovered by Goodsir in 1842 (*see* Parasites, Vegetable). This organism presents under the microscope a characteristic appearance, best to be compared to a corded wool-pack, hence

the name. The constituent cells, of a diameter of about $\frac{1}{16000}$th of an inch, are arranged in square groups of four, sixteen, or thirty-two. For an illustration *see* Microscope in Medicine, fig. 38.

Three species of sarcina are of interest in human pathology, namely—1. *Sarcina ventriculi*; 2. *Sarcina urinæ*; and 3, *Sarcina botulina*.

1. **Sarcina ventriculi.**—This species of sarcina is of frequent occurrence in the stomach, and in the vomit of gastric dilatation from pyloric obstruction; in some cases of gastric ulcer and carcinoma without dilatation; and in rare cases of gastric catarrh. Sarcinæ are not sufficiently constant to be of much diagnostic value, and are certainly not pathognomonic of a dilated stomach, as has been supposed. Their appearance is usually associated with a state of fermentation of the gastric contents, which appear like yeast, and are of an acid reaction and smell; but it would seem that the organism is developed in the progress of the fermentation, and is not the actual cause of the condition, for when placed in suitable surroundings, living sarcinæ have not been observed to set up fermentative changes, and cases are recorded by Beale and others of their occurrence in vomit that showed no signs of fermentation.

Sarcinæ are easily detected under the microscope. A drop of liquor potassæ added to a fragment of vomit on the glass slide, and covered with thin glass, is sufficient to display their characteristic appearances.

2. **Sarcina urinæ.**—This species of sarcina is of much rarer occurrence; and it is very doubtful whether it is not always developed after the urine has been voided. It is somewhat smaller than the gastric variety, but otherwise closely resembles it.

3. **Sarcina botulina.**—The 'sausage poison' has been attributed by M. Van den Corput to the presence of a species of sarcina, to which this name has been given. *See* Poisonous Food.

Sarcinæ have also been stated to have been found in the fæces, in a case of abscess of the lung, in the ventricles of the brain, in hydrocele fluid, in gangrenous intestines, and in cholera stools. W. H. Allchin.

**SARCOCELE** (*σὰρξ*, flesh, and *κήλη*, a tumour).—A name for any solid enlargement of the testes. *See* Testes, Diseases of.

**SARCOMA** (*σὰρξ*, flesh).—A tumour composed of some modification of embryonic connective tissue. *See* Tumours.

**SARCOPTES SCABIEI.**—A synonym for acarus scabiei. *See* Acarus.

**SATURNISM** (*saturnus*, lead).—A synonym for lead-poisoning. *See* Lead, Poisoning by.

**SATYRIASIS** (*σάτυρος*, a satyr).—A morbid desire for, and indulgence in, sexual intercourse in the male.

**SCAB.**—A rough incrustation formed by the drying-up of the discharge from a wound or an ulcer, or of the contents of a pustule. The word is also vulgarly used as a synonym for scabies.

**SCABIES** (*scabies*, scab, mange).—Synon.: Itch; Fr. *Gale*; Ger. *Krätze*.

Definition.—A simple inflammation of the skin, produced by the irritation of the *acarus scabiei* and the scratching of the sufferer.

Ætiology.—The cause of scabies is the presence of the acarus scabiei. Scabies is contagious, inasmuch as the parasite is easily transferred from one person to another. *See* Acarus.

Description.—The parts of the body most likely to be attacked are the soft skin between the fingers, and on the flexor side of the wrists and elbows; the lower part of the abdomen, buttocks, and penis; and in children the feet and legs. The acarus generally attacks both sides of the body symmetrically, and in adults is never met with in the skin of the face or scalp; but any other part of the body may be affected.

The eruption produced by the acari and by scratching is a scattered artificial eczema; and the extent and severity of the disease will depend chiefly on its duration. The most characteristic feature for the purposes of diagnosis is the scabies' burrow, which resembles roughly an old pin-scratch. Examined closely, it has a dotted and beaded appearance with ragged dirty edges at its entrance, where the roof of the cuniculus has been worn away by rubbing. At the distant end of the burrow may be sometimes seen the parent acarus, which is easily extracted by inserting the point of a pin along the burrow and touching the animal, which immediately adheres to the pin, and may thus be removed for the purpose of examination.

Diagnosis.—The following points serve to distinguish scabies:—(1) the particular parts attacked; (2) the eruption, which consists of scattered and isolated papules, vesicles, and pustules, with their tops more or less torn by scratching; (3) the history of the case, and especially of contagion; (4) the presence of the scabies' burrow; and (5) the demonstration of the acarus by means of the microscope.

Treatment.—The usual plan of treating scabies is by the use of either (1) sulphur ointment; or (2) sulphur baths or lotions. The former is the more effectual method, although the latter may be occasionally preferred. In order to cure an ordinary case of scabies, it is simply necessary that the patient, before going to bed, should thoroughly apply and gently rub in the sulphur ointment to every part of the body, excepting the skin of the face and scalp; and in order to keep the ointment in contact with the skin, he should sleep in his under clothes, such as drawers, jersey, socks, and gloves, and in the morning take a warm bath and put on clean clothes. The process should be repeated the next night; after which the ointment should be used, every night for a week or ten days, to those parts of the body only which are especially attacked by the disease.

The ointment should contain a drachm of sulphur to an ounce of benzoated lard, but for young children an ointment of about half this strength is most suitable. A common mistake is to continue the use of the strong sulphur ointment of the Pharmacopœia for several weeks, thus producing an irritable state of skin, which is mistaken for a continuation of the scabies.

If a sulphur bath be preferred, it may be made by dissolving half a pound of sulphurated

potash in thirty gallons of water. It is necessary to repeat the bath several times at intervals of a few days.

If it be desired to treat scabies by a lotion, Vlemingkx's solution may be used. It is made by boiling five gallons of water with a quarter of a pound of quick lime and half a pound of sulphur until three gallons are left. This lotion is effective, but it is apt to irritate the skin, and is not so generally useful as the sulphur ointment. R. Liveing.

**SCALD.**—An injury to any part of the body, caused by the action of moist heat, either in the form of steam or of a hot fluid. *See* Heat, Effects of Severe or Extreme.

**SCALD-HEAD** (Saxon *scall*, a separation or discontinuity of surface).—A popular term, commonly used as the negation of ring-worm; all diseases of the scalp, in the belief of the people, being either ringworm or scald-head. The term finds a more suitable application to that form of folliculitis of the scalp which is denominated *kerion*. Kerion begins with circumscribed tumefaction of the scalp and profuse exudation from the hair-follicles, and terminates by elimination of the hair and baldness; the latter being generally temporary but sometimes permanent. Erasmus Wilson.

**SCALY ERUPTION.**—The pathology of a scaly eruption is an excessive formation of unhealthy epidermis, which, instead of presenting the normal characters of that structure, is laminated and brittle, and falls off in the shape of scales. The scales offer various degrees of size and cohesion, some being minute, silvery, and micaceous, and others large and tough. Three scaly eruptions have been described by dermatological authors; the lepra vulgaris of Willan, now called psoriasis; the psoriasis of Willan, which is a chronic eczema; and pityriasis. But besides these, inflammation of the skin of whatever denomination, is attended with desquamation of the epidermis, of which the most striking example is dermatitis exfoliativa or pityriasis rubra. Erasmus Wilson.

**SCARIFICATION** (*scarifico*, I make an incision).—This is an operation in which small superficial incisions are made, either through the skin or mucous membrane, to allow the escape of blood, as in wet-cupping; of serous fluid, in relieving dropsical effusions; or to liberate the teeth, as in difficult dentition.

**SCARLATINA.**—A synonym for scarlet fever. *See* Scarlet Fever.

**SCARLET FEVER.**—Synon.: Scarlatina; *Febris Scarlatina*; Fr. *Scarlatine*; Ger. *Scharlach fieber*.

Definition.—An infectious specific fever, characterised by deep redness of the throat; a finely diffused scarlet rash, most intense on the third day, beginning to fade on the fifth or sixth with some subsidence of fever, and followed by desquamation of the cuticle, in both small and large flakes; and afterwards possibly by rheumatic or renal symptoms, with a tendency to serous effusions.

Ætiology.—Some product of the sick, however conveyed to those hitherto unaffected, especially the young, always reproduces this disease, which again gives off infecting material with identical properties. No other origin for scarlet fever can now be admitted; its extension to any new locality is traceable to an imported infection. The periodical recurrence of epidemics in large communities is mainly attributable to an increase in the number of the susceptible. Wherever scarlatina spreads, children are the chief victims. Even among people not protected by a previous attack, a less liability is noticed with advancing years.

In adults, unless specially predisposed, the attack is less severe than during adolescence and childhood; young infants often escape or have the disease in a mitigated form. In England, where scarlet fever prevails more than in any other country, except perhaps the United States, and causes the highest mortality of any epidemic disease, two-thirds of all the deaths from it occur in the first five years of childhood. Five per cent. of the whole mortality falls in the first year, fifteen in the second, twenty per cent. in each of the two next years, thence progressively decreasing, that for all ages over fifteen being less than five per cent., and more than half of those deaths being in the next decade. The following decade shows a slightly increased incidence on women, partly because they are more with the sick, and partly from a greater susceptibility after childbirth. Sex has no directly predisposing influence. The proportional mortality from this cause is about eight to ten thousand of population in England and Wales, the range being from 0·5 to 1·5 per 1,000; in Liverpool this has reached to 3·7, and in London to two per thousand. From two to five per cent. of all the yearly deaths are from this disease; in London this proportion varied from eight per cent. in 1870, to one per cent. two years afterwards. Epidemics of scarlet fever are not evenly distributed—they subside in one place, while they extend in another; in epidemic years (as 1863 and 1870) the increase becomes very general.

The fatality of 3,984 cases treated in special hospitals in London in three years, 1877 to 1879, was 449. The death-rate ranges from 6 to 16 per cent. Taken generally, the proportion of deaths to attacks must be near ten per cent.; nor is this rate of fatality less in non-epidemic years, or in seasons when the disease is less prevalent. It varies greatly in different epidemics, and in different communities, only in limited puerperal epidemics ever reaching the high proportion measles sometimes does. Sometimes it passes as lightly as measles often does, but it is very often much higher. Consequently, since many more children have measles and fewer die, while many families escape scarlet fever altogether and the deaths from it are double those from measles, the proportional fatality of scarlet fever is much greater than in measles. In both diseases many of the milder cases escape notice, and so the rate given may be too high.

The influence of season on scarlet fever is marked with us by an autumnal increase of the disease; the number of deaths from it in London is always at its highest at the end of October. Cold has very little effect on the intensity of the disease; in many indirect ways it may check its

spread. Heat favours its diffusion, but lessens the severity of the attack or of its after-consequences. Epidemics tend to recur every five or six years, as a fresh series of the susceptible arises. They often extend with us in dry seasons, and subside after wet ones. In opposition to some views of the relation of moist air and subsoil water to infection, we see rain wash the air of floating particles, and carry off others by the sewers.

A defective hygiene from imperfectly drained dwellings greatly increases the dangers of this disease. Defective ventilation will aggravate the type, or intensify the infection which a free ventilation would dissipate. The best conditions of personal hygiene are often powerless in modifying the dangers of individual liability; the healthy and well-to-do enjoy no exemption; no mildness of type in the infecting source is any safeguard against the dangers to follow, even to members of the same family. Individual susceptibility is most variable; sometimes persons in not very good health escape while with the sick, but on returning in improved health to them as convalescents, or to the house they have left, are at once seized. After surgical operations the predisposition to receive infection is increased; any shock or injury may determine a seizure after an exposure otherwise harmless. How long after quitting an infected place such injury may excite disease is uncertain. An idiosyncrasy to suffer seriously from this kind of disease marks even the robust in certain families; in others there is a liability to more than one attack. The rule against a recurrence prevails so largely as to be the great element of personal safety to anyone again exposed to infection. Any person, however safe, may be the carrier of infection; not only the hands that have touched the sick and things in actual contact with them, but clothes or even papers that have been in the sick-room may convey it.

Infection attaches to the whole period of illness. Greatest at the height of the disease, it is given off for six weeks, it may be for nine and ten weeks after. A recrudescence or relapse is possible as late as the fourth week; this, if not a re-infection, prolongs the duration of the infectious period; so also may any serious complication delaying convalescence. During all this time infection may be received by clothes or near surfaces, and retained by them for months, unless driven off by cleansing and disinfectants. A dry heat of 212° will disinfect woollen clothing; a curtain from the bed of a child only sickening for scarlet fever, folded and put away without such care, has set up the disease after a long interval. Clothes removed to a distance and unpacked months afterwards will give off infection. Persons protected by a previous attack from again undergoing scarlet fever, when much exposed to it may have sore-throat or other signs of partial sickening, sufficient to start the disease elsewhere. Every case of sore-throat occurring in an infected house is capable of conveying scarlet fever, whether the subject of it be protected or not. Sore-throat in children is always a sufficient reason for keeping them at home. It is the slight cases of infectious sore-throat, not bad enough to prevent children from going out of doors, or even to schools and parties, that elude our efforts to arrest epidemics of this kind in their usual course. Infection begins at the very commencement of sickening, but at that time is more readily controlled. Scarlet fever having gained entrance into a healthy house need not spread; timely isolation of the first case, or separation of the susceptible, is mostly successful, for the rash is an early symptom at once attracting attention. If others have received infection the sickness will appear in less than a week, when a second separation is sure to be effective. Till the week is over those who may have escaped are not to be sent among other families.

The period of incubation is a short one: not more than from three to five days, it may be as short as three hours; it may possibly extend to seven days. The longest clear interval from a single definite exposure to sickening has been four and a half days. In most of the instances where four to five days have intervened, two or three of these days have not been without sore-throat or other signs of invasion. It is such cases that are infectious before the seizure is definite. In separating children from an infected house anyone who has received infection is sure to show evidence of it before the week end. The only exceptions to this rule are, where some communication has been kept up with the infected house, where clothes have retained infection, or some source of it has existed in the second house. All accurate investigation of the cause of infection in scarlet fever tends to reduce the estimate of the average incubation-period to less than three days. In the longer periods adduced it is probable that infection attaches to something without, instead of immediately acting on or within the sufferer. A week or more may intervene between successive cases in any family, when precautions sufficient only to delay the spread of infection have been maintained.

Inoculation will reproduce scarlatina, all the symptoms appearing with the usual rapidity and not less than the usual severity. Some modification has resulted from inoculating a serous exudation from the skin during eruption; redness began at the point of insertion in thirty hours, this extended during three days, faded after five days, and proved protective. Attempts at implanting the disease by desquamated epidermic scales have mostly failed; as with diphtheritic exfoliations, the active contagion is not long or intimately associated with dead material. The particulate contagion, carried in the blood, can permeate everywhere, for mothers ill from it have given birth to infants affected with angina; yet the mother may suffer, and the child escape. Animals are inoculable with the blood of persons with scarlet fever. A dog has contracted fever and bad throat from being in bed with a scarlet fever patient; such illness is not necessarily identical with that originating it, nor need it be directly transmissible as a specific disease either to dogs or men, but here is a way in which animals may carry infection from one person to another.

Infection has many times been traced to milk. The facility with which this fluid will absorb and convey infection is very remarkable; for it to stand in the room with sick people is enough to cause it to be tainted; the cream is specially

prone to impregnation. In some cases convalescents from scarlet fever, in others healthy persons coming from an infected house, have milked the cows, and handled or distributed the milk. In no case has any diseased state of the cows been discovered to exist.

Pathology and Anatomical Characters.—Scarlet fever results from the entrance of an infecting particle into the blood; how minute or of what nature is uncertain. Micrococci are found in the blood during this fever, even within the globules; and in the serum rapidly oscillating bodies appear as dark specks among the globules (× 500); also rod-like bodies made up of three or four of the more minute ones. Such serum injected under the skin caused sudden fever in the rabbit, with similar bodies in the blood, again inoculable. Not only the blood and serum of the subject of scarlet fever, but most secretions of the body carry infection. Minute spores, similar to those in the blood, traverse membranous septa, and have been found in the renal epithelium. Most abundant in the breath, infection attaches also to the nasal or pharyngeal secretion. The first serous exudation from the skin has been used for inoculation; desquamated cuticle is less effective. Infection is generally received by the throat and lungs, seldom by a wound or abrasion of the skin, and never by the unabraded skin; at first it multiplies at the point of reception, hence probably the day or two of sore-throat; and is delayed but little in the lymphatics before entering the blood. Infection is most rapid when carried direct to the lungs, as when inhaled through a tracheotomy tube, no particles being detained on the pharynx. Many of the first effects of the disease, such as the quick pulse and nerve-disturbance, are directly attributable to the high temperature. The state of the skin adds to the fever; secretion is checked; there is a general hyperæmia, not specially of the papillæ as in measles, with serous exudation in its upper layers. A bad throat gives rise to irritating and injurious secretions, keeps up the fever, and interferes with the supply of necessary diluents. The products of increased tissue-change are imperfectly eliminated by the kidneys. Further stress on the kidneys is caused, partly by the high fever, and partly by a special irritant in the blood acting upon its vascular and secreting structures. The vascular changes occur early, chiefly in the cortical part; the glomeruli are obstructed; there is a proliferation of epithelial nuclei in the Malpighian corpuscles, distending them to twice their size, and so compressing the vascular tuft; there is hyaline degeneration of their capillaries, and in the elastic intima of the afferent vessels, which has been found after two days' illness (Klein); also thickening of the small arteries in other parts, with germinating nuclei in the muscular coat. The brunt of the disease falls first on the glomeruli; thence arise stasis and hyperæmia of intertubular capillaries; then signs of parenchymatous nephritis, with cloudy swelling of epithelium-cells, increase of their nuclei, and granular change in some of the convoluted tubes may be found. Sometimes there is granular matter or blood in them, and in the cavity of Bowman's capsule. Epithelium in some cases begins to be detached from the larger ducts of the pyramids. After the first week changes due to interstitial as well as to parenchymatous nephritis commence; the connective tissue round the larger vessels is infiltrated with lymphoid cells, thence spreading to the base of the pyramids and to the cortex, some parts of which become pale and firm, and the tubules obliterated. After this process has reached a certain degree the evidence of parenchymatous change increases—crowding of the urinary tubes with lymphoid cells, granular and fatty degeneration of epithelium, with casts or cylinders of various kinds in the tubes, and abundant products of inflammation. These changes may commence round an artery plugged with fibrin; they lead to enlargement of the kidney, with obliteration of tubules and Malpighian corpuscles, the latter undergoing fibrous degeneration. Klein also describes early interstitial hepatitis. He found the same hyaline degeneration and thickening of arteries in the spleen and intestines as in enteric fever, but most marked in the spleen, with degeneration of surrounding adenoid tissue. Veins obstructed with fibrin were found in the cervical glands, with degenerative changes; in the centre of the lymphatic follicles here, and in the pharynx and tonsils, the lymph-cells were replaced by large granular cells.

Thickening of the walls of the smaller arteries, and some change in the capillaries of the pia mater, have been noticed in this as in other acute fevers, otherwise the early cerebral symptoms are not marked by anatomical change. In uræmia leucocytes are found in the perivascular spaces of the brain and cord. Later cerebral mischief, except from caries of the temporal bone, is more rare than after measles. Hemiplegia from embolism has occurred in the second week of scarlet fever. Besides the results of endo- and peri-carditis, blood-clots and fibrinous coagula are found in the heart. The blood in scarlet fever has been said to be deficient in fibrin; it is less readily formed in this, as in other specific fevers, until some secondary inflammation arises; in the after dyscrasia it more readily separates. Tubercular peritonitis has followed.

Ulcerative endocarditis, or suppurative synovitis, almost as certainly fatal, may occur. Among the secondary lesions of scarlet fever are the ulceration and suppuration of inflamed glands, with sloughing of the cellular tissue around them or in other parts. Fatal hæmorrhage has resulted from an injured artery. Good recovery has been made after sloughing in the neck has extended to the sheath of the carotid, exposing all the deep muscles, and leaving the salivary glands bare but uninjured.

Symptoms.—The invasion of scarlet fever is abrupt. The ingress of fever is seldom marked by rigors, not always by chilliness; slight pallor, languor, vertigo, drowsiness by day, restlessness, starting, or delirium at night, aching of the limbs and forehead, sore-throat, and vomiting, are constant; in children convulsions or coma may occur. Sudden illness comes on within an hour of apparent health, or after a day or two's warning sensations in the throat. The temperature begins to rise at once, the pulse becomes very rapid, and this at first is

perhaps more marked than the rise in temperature; but soon suffusion of the eyes, flushing of the face, and great heat succeed, with thirst and pain in deglutition, or some stiffness of neck. The lymphatic glands at the angles of the jaw can be felt enlarged and tender; already the arch of the palate and both tonsils are red; the redness extends a little on to the palate; the tongue is furred, not red, except at the edges and tip. Very often a fine flush of redness suffuses the neck and chest soon after the sore-throat is complained of, perhaps within a few hours of the first suspicion of illness. The eruption may thus be among the earliest obvious signs of the disease; it generally appears by the second day, and is well established on the third, or it may be delayed, suppressed, or recede, when the severity of the prodromata serve as a guide. Coma, convulsions, or vomiting may persist, with considerable depression, and yet the temperature be near 105°; it may even reach 106° Fahr. at this time. More frequently the greatest disturbance of pulse and temperature is from the the third to the fifth day.

The *rash* begins in fine red points, closely spread over a large surface; the specks, brightest in the centre, fade into each other so as to leave no clear skin between; not raised above the widely diffused flush, they disappear under the pressure of the finger, and return directly it is removed. These bright dots may be closely set, forming red patches in some places, or be more scattered in others, and these may seem to be slightly raised before the skin is turgid. The red patches are well seen in the flexures of the joints; the finger-nail drawn firmly across this redness on the abdomen or thigh leaves a white streak where the vessels contract for a time; after steady pressure the skin is of a yellowish tint; or petechiæ may be seen. The sides of the neck, the face, and the chest first show the rash, which soon spreads to the trunk and limbs; or it may come out on them at once. The skin is of a burning heat, not always dry, sometimes with free perspiration; miliaria often appear where the rash is most intense; these minute exudations are not the result of perspiration, though sudamina may occur. The eruption reaches its fullest extension and intensity by the fourth day, fading on the fifth and sixth. The heat and swelling then subside, and the skin feels dry and inelastic, or a partial subcutaneous œdema of the eyelids, feet, or hands is noticeable; in other parts the cuticle is easily thrown into fine wrinkles, and is ready to desquamate; this begins from the sixth to the ninth day, when the specific morbid process is subsiding.

*Sore-throat* is always present; during the day or two before the seizure, and almost from the time of receiving the infection, some traces of this are observable. During the attack the redness spreads from the tonsils to the palate, uvula, pharynx, and epiglottis; it becomes more intense; and there is swelling with some œdema. The mucous membrane is either dry and shining, or coated with thick mucus clogging the fauces; the tonsils project and are smeared with sticky secretion, while sometimes there is abrasion of their surface or slight ulceration, rarely abscess. These conditions and the symptoms they produce are worst during the first three days of the illness, and subside as the rash is thrown out. After the first week, in severe cases, ulceration, not confined to the tonsils, may occur; the connective tissue around the lymphatic glands in the neck becomes brawny and may slough, or that under the lower lid suppurate; persistent coryza stuffs the nostrils with acrid discharge, or, extending along the Eustachian tube, fills the middle ear with pus, bursting the tympanum, deafness not being the only or worst result. Otorrhœa from the meatus is less serious; this is not at first purulent. The tongue is red and bare after the eruption, the white fur clearing from before backwards; the mucous surfaces are left tender, and care as to ingesta is required; there may be also much and serious trouble with deglutition; vomiting, the most constant of the ingressional nervous signs, rarely persists as a gastric symptom; sometimes there is a tendency to diarrhœa, but constipation is rare, except as an after-consequence.

The *pyrexia* of scarlet fever is characteristic; high at the first, it keeps high, or rises higher for three or four days; there is then a marked, though incomplete subsidence after the rash is thrown out, mostly on the fifth or sixth days, sometimes earlier; but the temperature rarely becomes normal till the second week, some fever lingering after the eruption is over. When the greatest tension of skin is passed, the surface temperature has been found on the fifth and sixth days at 97°, with 101° *in axillâ* and 105° *in recto*; the latter keeping at 103° for two or three days longer. A crisis is to be looked for on the fourth or fifth day; defervescence not till the eighth or ninth; and this is often further delayed by complications or relapse. There are no other constant remissions during the febrile period, but some nocturnal exacerbations occur during the first part of it, often associated with harmless delirium. The persistence of more serious delirium then and later in persons of all ages points to meningeal irritation; coma in children may depend, not only on the high temperature, but on the state of the arachnoid cavities; even hemiplegic signs have occurred independently of the embolism so often consequent on endocarditis; uræmic coma is rare; intra-cranial inflammation and abscess not unfrequently result from caries of the temporal bone after otitis.

The chief respiratory disturbances are, at first irritative cough, and symptoms resulting from œdema of the glottis; the breathing is always quickened when the pulse is rapid and the fever high. Pleurisy with effusion has occurred at all periods of scarlatina, more frequently in the later stages, with a limited pneumonia, pulmonary congestion, or broncho-pneumonia.

On the side of the circulation, besides the quick pulse, there is the liability to endocarditis during the eruptive period or later, and to pericarditis; these complications often prolong the duration of the fever, and give rise to special symptoms and dangers.

The urine is altered as in other fevers; the increase of nitrogenous waste, in proportion to the degree of fever, is eliminated most largely at the crisis. At first the quantity of urine is less; the chlorides, much diminished, reappear as the

fever declines; the urea, relatively increased, is less absolutely so than it is afterwards with a freer excretion; urate of soda is deposited; uric acid, diminished on the second and third days, increases at the febrile crisis, often appearing in abundance on the fifth and sixth days, then again normal, but increasing after rheumatism or other febrile disturbance; phosphoric acid, normal during the first four days, is much diminished on the fifth, then remains below the standard till the eighth or ninth day, when there is often a deposit of earthy phosphates, with a pale, barely acid urine. Oxaluria may follow.

The *kidneys*, almost as constantly as the throat and skin, are the seat of important changes, to which the state of the urine is a trustworthy guide; this consequently must be the subject of repeated examination. At first there may be suppression of urine for more than one day; this yielding, tube-casts, blood, and albumin are found, clearing off as the secretion becomes freer. Such transient albuminuria may occur in other fevers, but here the first congestion of the glomeruli increases—it may be while the skin-affection is at its height, more frequently in its decline—and a distinctive form of nephritis is set up, generally about the ninth and tenth day, when the skin is desquamating. This has a marked febrile disturbance of its own, often leads to chronic kidney-disease, and is attended throughout with albuminuria. Later in the disease albuminuria and hæmaturia set in without rise of temperature. Both these conditions are often followed by dropsy. Albuminuria commonly begins during the desquamation-period in the second week; possibly as early as the fourth day; rarely for the first time, with fever or signs of kidney-irritation, after the twenty-first, but even as late as the thirty-first day. Three stages of this condition are noticed. The quantity of urine in the first stage is much diminished, the urea even more in proportion than the water; the specific gravity is increased; the turbidity from urates deposited is cleared by heat or the addition of hot water, showing no smoky tint from blood; if this stage be prolonged, albumin is found, with finely granular or clear casts, seldom with blood-discs or renal epithelium; but they, together with epithelial tube-casts, are freely washed out as this stage is passing away. The second stage is marked by diuresis; the pale urine of low specific gravity acquires a smoky tint from blood-discolouration; this may deepen to brown or give a brighter red deposit; albumin to a large amount may pass, with pale urine, when there is but little blood; the whole quantity of albumin may be greater, though proportionally less than in the earlier stage; it diminishes towards the close of this period, as the urine gradually clears; some blood-corpuscles, renal epithelium, and tube-casts are found in the deposit. Clear urine still in excess and slightly flocculent, marks the third stage, in which the albumin gradually, but not always entirely, disappears.

The urine may not be much lessened, at first, in mild cases, and yet afterwards become albuminous; or a well-marked first stage in a severe case is not always followed by albuminuria. This is often a specific effect of the disease, and independent of chill. There may be hæmaglobinuria in the later stages, with deep bloody colour, and no great increase of albumen.

Hæmaturia, if partly dependent on a blood-state, is one of the more obvious indications of kidney-mischief. Another is afforded by the occurrence of scarlatinal dropsy. Allowing for an error from mere surface-œdema being mistaken for it in the first week, and later for the effects of anæmia, anasarca is fairly indicative of albuminuria past or present.

Albuminuria may be absent, or only have existed for a day or two before the anasarca or ascites began. Anæmia is a very marked late feature of the disease, so that pallor and chronic dropsical cachexia often go together. Apart from renal dropsy, there is a form of scarlatinal dropsy which occurs suddenly in the second or third week, as the result of a special inflammation of serous membranes, often associated with rheumatism, or with some degree of albuminuria. Serous effusions into the pericardium or pleuræ, indicated by dyspnœa, are ascertained by their distinctive physical signs. They are part of a general tendency to inflammation of the serous membranes. Pleurisy is more commonly associated with albuminuria; it may tend either to hydrothorax or to empyema. Pericarditis is more commonly associated with rheumatism.

Rheumatism is frequently induced by scarlet-fever; before the end of the first week, just after the rash is fullest, pains begin in several joints—wrists, ankles, or knees; the fever, instead of subsiding, rises; and the pulse again becomes quick, full, and hard. At this time pericardial friction is to be looked for, or an endocardial murmur may be heard either at base or apex; an apex murmur is sometimes heard when there is neither rheumatism nor albuminuria, and may not necessarily mean endocarditis. Pains in the limbs, or arthritic symptoms, may come on as late as the third week, with renewed fever of the rheumatic type, sometimes with profuse perspirations; the articular swellings mostly subside, but there is also, unlike what is seen in rheumatism, the possibility of suppuration.

Sloughing of the cellular tissue around inflamed glands, or of the skin over them, is a more frequent and less fatal evidence of the same tendency. Sometimes diphtheritic necrosis of mucous membrane, or of blistered and ulcerated surfaces, after scarlet fever, evinces a specific dyscrasia.

Desquamation begins earliest where the rash has been most intense; it may be seen as early as the fourth day, more frequently on the sixth and seventh; rarely it is delayed beyond the tenth day; it may be to three weeks; and it is seldom completely over in less than six weeks. The desquamation-period, really the whole time of cure, is also spoken of as occupying the second week, and as marked by a subsidence of fever even to below the normal. There is generally a remission of fever at this time, but without any great depression of temperature; the pulse also is weak, and may be irregular; considerable depression and a sense of debility about the tenth day are frequently to be noticed. All this, if coincident, can hardly be consequent upon de-

squamation. As soon as the vessels of the skin are less tense, the wrinkled epidermis becomes scurfy and separates. This is first seen on the chin and sides of the neck, the less delicate cuticle being raised and removed on small patches, which increase as the edges are detached, leaving a large new surface of skin; the thick epidermis of fingers and feet peels off in larger flakes, or in casts. A shreddy look of hands or toes may betray a mild attack of scarlet fever, overlooked from three to six or eight weeks before.

New cuticle is rapidly formed during convalescence, and is more than once cast off and renewed. Sometimes there is a pause in this process, and desquamation is thought to be over, when, with change of air or improved nutrition, a further peeling of what seems healthy cuticle occurs, not without risk of a further dissemination of infection, up to the ninth week of convalescence. Any form of desquamation beginning later than this can seldom or never be the bearer of infecting particles; even the flakes of a second desquamation carry infection so loosely as to be readily deprived of it by the ordinary means of washing and exposure. In fact, desquamation, though a very good sign that infection still attaches to its subject, because recovery is barely complete, is not the only, nor even the chief, means of its diffusion. It is only the fine dust first rising from the surface, just after the rash is at its height, and especially when attended with miliary exudation, that is charged with the intensest essence of infection.

But infection is given off before this is formed, as well as after it is cast off. The secondary lesions of the throat, nose, and lips are infectious; abscesses, formed more than three weeks after the disease began, yield an infecting pus contaminating specifically the lancet used for their evacuation; nor can any definite time less than six weeks be fixed when the specific morbid process may be supposed to have ceased. A kind of recrudescence, but without the reappearance of the rash, would seem possible up to the eighth week; and, as in menstruation, the casting off in the tenth week of débris of tissue formed perhaps a fortnight before, may not be without the elements of infection. Children are very liable to weak throat or a return of coryza for some months after convalescence from scarlet fever; also to ecthyma, eczema, or psoriasis long after all possibility of infection has ceased.

Varieties.—1. *Scarlatina mitior*, called also *Scarlatina simplex* or *benigna*. The rash appears only on parts of the skin, and soon fades; the throat, hardly sore, is of a pinky red, with tonsils just rounded, the back of the pharynx, perhaps, streaked with mucus from the small glands; the fever is so slight that it is said to be absent; the early fine desquamation escapes notice; and it may be three, four, or five weeks before peeling on the hands and feet proves the true nature of the illness. In some mild cases the rash is well-marked, but there is no high fever; the temperature, not exceeding 102°, falls on the third or fourth day. In neither of these cases is apyrexia complete till the third week; but there is no great illness, the rash is forgotten, and precautions are relaxed till some anasarca is noticed, or others are ill with more marked symptoms. Desquamation is not later after a mild attack, nor more prolonged than after a severe one, but it may be the only distinctive sign left of a marked impairment of health and of its cause.

2. *Scarlatina gravior.*—This includes all the more serious cases, some called *Scarlatina anginosa*, when endangered by the severity of the throat-symptoms; others *Scarlatina maligna*, when marked from the first by high fever or its consequences. This latter form is known also as the *adynamic* when exhaustion or collapse rapidly ensues, in some cases even before the rash has had time to appear. There are all grades of severity between these and the slighter forms of the disease. We sometimes see the mildest kind of attack in one child set up the worst form in another; or the disease may begin moderately, and bad symptoms appear on the third or fifth day, such as restlessness, depression, weak and rapid pulse, dusky rash, lividity or pallor, dysphagia, sore mouth, dry tongue, tympanites, and cold perspirations. Again, these signs of exhaustion may follow upon some complication in the second week, while the temperature is still high; or appear as late as the fourth or fifth, after great emaciation, when the fever is over. Diphtheria, either of mucous surfaces or of the skin, appears in some of these cases, not as a new infection, but as one result of the disease. So among several children with scarlet fever, one may have only a faint rash, slow to appear, soon fading, or perhaps again returning, called *Scarlatina anginosa maligna*; but the appearances in the throat and other signs are those of diphtheria; or one child with such a throat and no noticeable rash has started scarlatina among others. Some malignant cases, mostly fatal, show extreme prostration from the first, with rapid pulse and grave nervous disturbance; the temperature is always high—105° or more, even when the skin feels cool. Several of these fatal cases follow one another in a household, either from a developed intensity in the infection, from a family predisposition to suffer from it, or from some such tendency to excessive temperature-disturbance.

The infection of scarlet fever is readily received, by those who have not previously suffered from it, in the course of most diseases; and in many of them it proves a serious complication. Surgical scarlet fever differs in no respect from ordinary scarlet fever; it will spread to the susceptible who have no wound or open sore, not to those who are protected by a previous attack, though in the same ward and recently operated on. One attack of scarlet fever is so generally protective against a recurrence that the not infrequent instances of exceptions to this rule in no way invalidate the more important practical deductions from it; those who have already had it may attend on the sick or mix with convalescents. Some persons have two or three attacks, or are liable to sore-throat whenever they come in contact with it; still the rule is constant enough to be depended on for purposes of diagnosis.

Diagnosis.—The sudden illness, with high temperature, quick pulse, and severe nervous symptoms, without previous cough or sneezing, but with sore-throat and tender swelling of the glands at the angle of the jaw, at once point to

scarlet fever in a child who has not had it; this is made certain by the early rash.

Diphtheria may come on in the same way, with slight suffusion of face, or more insidiously, but the throat-signs are distinctive. Herpetic sore-throat has a shorter febrile stage, and no rash. The rash of rubeola is in spots, and less diffused at first; in doubtful cases, perhaps called febrile roseola, albumin is to be looked for in the first fortnight, and desquamation afterwards, before an absolute diagnosis from rubeola is formed. Erythema may result from septicæmia, and from mercury, arsenic, sulphur, iodine, bromides, chloral, salicine, quinine, copaiba, ipecacuanha, belladonna, opium, and oil of turpentine—the two last only of these followed by desquamation.

Prognosis.—Caution is needed in the prognosis of the mildest cases of scarlet fever, as these are not exempt from all the complications of the illness, or the accidents of convalescence.

High initial fever, severe angina, fever rising on the fifth day or persisting beyond the tenth, and great depression, all betoken danger. There is danger from sloughs and secondary suppuration; from cardiac inflammation and its consequences; and from kidney-disease, either at first, or from albuminuria slowly increasing for two or three months; the earlier effects of renal dropsy are of more hopeful prognosis. Family predisposition is to be considered, as well as the age of the patient; individual susceptibility more than the character of the prevailing epidemic. The temperature has reached 111° Fahr. with recovery, and 115° in a fatal case.

Treatment.—This must have regard to the care of the patient, and the safety of others. All cases must be treated in bed for two or three weeks; a hair mattress, not too thick, is better than a feather bed, and no extra covering is required. Carpets and woollen curtains should be removed from the room; this must be kept cool and well-ventilated by a partly-open window and an open fire, but without draughts that come directly on to the patient. A linen screen suspended before the door is useful; a basin of water made pink with permanganate of potash should stand ready, in which to dip the fingers, or anything used by the patient; a stronger solution is required for the immersion of body linen when removed, or for the excretions. No medicines will cut short scarlet fever; simple salines, as acetate of ammonia or chlorate of potash, which act slightly on the skin and kidneys, tend to its mitigation if plenty of liquid be given. The best relief is obtained from tepid sponging over the whole body, part at a time, twice in the twenty-four hours, or a tepid bath, and oil or cold-cream used to the skin afterwards. Where the fever is not very high nor the rash intense, a warm bath is comfortable. The hot pack is injurious, most so when the rash is imperfect and the nervous disturbance indicates excessive body-heat. In such cases cold affusion or the cautious use of the wet pack would moderate fever; but these means must be so used as to soothe and not to tire the patient. Frequent enemata of cold water supply fluid to the body and reduce temperature. It is not until after the fever is over that scrubbing with carbolic soap, and detergent baths, with carbolic inunctions, should be practised. During the fever a little Condy's fluid, or aromatic vinegar, added to the water for sponging the body, or the solution of peroxide of hydrogen, is agreeable and refreshing, neutralising some of the morbid exhalations, if not quite disinfecting them. For this latter purpose strong acetic acid (1 to 5), or carbolic acid (1 to 20 of oil), would be required. Carbolated oil (1 to 40) can be used with advantage from the first, so that the earliest skin-dust may be intercepted. Condy's fluid sprayed into the room at times sweetens the air, or chlorinated soda may be sprinkled about the room.

The throat-symptoms often claim early attention. Swallowing soon becomes easier and the external swelling less after small lumps of ice have been repeatedly held to melt at the back of the mouth; young children can have a teaspoonful of iced-water with a morsel of ice in it given frequently; older persons find relief from inhaling steam. A warm compress with cotton-wool over it should be applied round the neck. Puffy swelling over the glands is often removed by fomentation, or by warm linseed poultices constantly renewed. A warm poultice held close up to the ear relieves pain from the tonsil. Mischief within the throat is lessened by taking chlorate of potash into the mouth, or by the solution of it in spray; a sloughy throat requires chlorinated soda solution, one part to ten of water. Here also the acid chlorine mixture is useful; it is made by dropping strong hydrochloric acid on to chlorate of potash in a bottle (♏3 of the acid and gr. j of the salt to each ounce of capacity), and then adding water to dissolve the liberated chlorine. Large doses of chlorate of potash are objectionable, as tending to renal irritation. For the control of fever eliminants and depressants are to be avoided; aconite is not needed in the mild cases of fever and sore-throat; it is prejudicial in the more severe forms. The mineral acids moderately control heat-production, and may be given diluted from the first. A tendency on the fifth day to increase of an already high temperature has been checked by the substitution of acids for salines. In all cases with high temperature stronger remedies of this class are required. Of these, the two most effective and most suitable in scarlet fever are quinine and digitalis. Of the former, two or three doses, on the third or fifth day, at the rate of one grain for every two years of age, reduces fever, and so prevents the worse forms of throat and kidney mischief. If the urine be scanty, or already contain albumin, digitalis is to be preferred; it is of marked benefit where the pulse has been much accelerated in the early stages; and it is specially suited to combine with iron in the later stages of the disease, or with iron and a saline when diuretics are required. The combination of digitalis and quinine in all the graver forms of scarlet fever seems to be specially indicated. The sulpho-carbolate of soda has been used with more advantage than the newer derivative of carbolic acid, the salicylic. Salicylate of soda is not well suited for administration in scarlet fever, as the acid is secreted by the kidneys and may irritate them; when given it has caused perspiration and reduced the pulse and temperature, but the worst symptoms of bad cases were not lessened by it, while

the tendency to rheumatism and to albuminuria were increased. It is effective against the rheumatism that follows scarlet-fever when there is no kidney-lesion. In most of these cases perchloride of iron in full doses is the best remedy. Acute kidney-congestion should be treated by dry-cupping to the loins, hot epithems round the body, or a warmly-packed poultice across the back; a brisk aperient is often most useful at the beginning of this as of other secondary complications. Here free secretion from the bowels is to be favoured by salines, and their diuretic action should be aided by plenty of liquid. Free action of the skin can be obtained by the hot-air bath, or by the hypodermic injection of pilocarpin. Two drops of a 5 per cent. solution of the muriate answers well; the sixth of a grain will produce perspiration in an adult; or one-twentieth of a grain may be given every hour till perspiration ensues. Children require full doses of pilocarpin, up to one-tenth of a grain twice a day in azoturia. More urea and less water has resulted after some days' use of it. Diarrhœa at the febrile crisis seldom need be checked; care as to ingesta, and warm applications or poultices, perhaps with a little opium externally, suffice for its relief. Great caution is required at all times in the use of any opiates; there are many soothing means which promote sleep without resorting to direct sedatives. Chloral is not very suitable.

The diet, at first limited to milk and liquids, may consist also of eggs and beef-tea as soon as more food can be taken, with fish or fowl, and soup with vegetables. Lemon-juice, oranges, or grapes may supplement the vegetable-supply in rheumatic or renal complications. Caution is required as to meat, and even the supply of beef-tea should be limited, while milk can be given *ad libitum*, and eggs may be largely depended on. Alcoholic stimulants are only to be used with great caution; they are apt to excite a return of fever if given early, and may embarrass the restoration of the kidney-function; still there are many bad cases where a little brandy has to be added to the egg and milk, or where wine must be allowed. Moreover, after high fever a condition like that of heat-exhaustion comes on, with shallow breathing, weak, slow, or irregular pulse, cool surface, restlessness and threatened collapse, where brandy, ammonia, bark, and even opium may be needed. During convalescence chill and fatigue must be guarded against. Careful diet is required, and some preparation of iron with meals, or bitters and bark as tonics. We must not advise change of air too soon; three weeks indoors for the disease to cease, and three weeks at home after that, for restoration of health, is the safest rule for all. Warm baths on three or four successive days, with plenty of soap to remove all roughness of skin, and fresh woollen clothing, are required before leaving the sick-room. The hair should be dressed with carbolic oil after washing, or with a mixture of acetic acid, glycerine, and spirit. Infection can be removed from clothes and bedding by stoving all that does not undergo a heat of 212° in washing. The best means of disinfecting the room, and what is not easy to remove from it, is by burning sulphur or bisulphide of carbon in it. An ounce and a half of sulphur should be burnt for every 100 cubic feet of clear space. *See* DISINFECTION.

No convalescent should mix with susceptible children until six weeks from the seizure, however slight the attack; if convalescence have been interrupted, or some after-effects of the disease remain, this interval has to be two or three weeks longer. Those much with the sick should wash their hands after assisting the patient, and change their outer dress on leaving the room. A solution of salicylic acid in glycerine promises to be of some use in clearing infectious particles from the throat, and so may act as a preventive against one mode of infection. No true prophylactic is known.

WILLIAM SQUIRE.

**SCHINZNACH, in Switzerland.**—Sulphur waters. *See* MINERAL WATERS.

**SCHLANGENBAD, in Germany.**—Simple thermal waters. *See* MINERAL WATERS.

**SCIATICA.**—SYNON. . Fr. *Névralgie sciatique*; Ger. *Hüftweh.*

DEFINITION.—Neuralgia in the district of the sciatic nerve.

Sciatica is signalised by paroxysmal pain in any or all of the following localities: the buttock; the back of the thigh; the knee; the front, back, and outside of the leg; and the whole foot except its inner border. The condition is frequently of peripheral origin, and is then dependent on inflammation of the sheath and surroundings of the nerve-trunk. Or it may arise independently, to all appearance, of any local cause in the nerve itself, and is then probably caused by some impairment of nutrition of a nerve-centre. As the diagnosis of peri-neuritis from neuralgia is as yet not certainly differentiated, the two conditions will be considered together.

ÆTIOLOGY.—*Predisposing causes.*—The predisposing causes of sciatica are arterial degeneration; anæmia; the rheumatic and gouty diatheses; the toxic influence of malaria, chronic alcoholism, syphilis, and lead; inherited neurotic disposition; fatigue; and a damp and cold climate.

*Exciting causes.*—These include exposure of the limb to a draught of cold air for some long time, which is a common source of the affection; sitting on a cold or damp seat; overwalking; strains; concussion of the spine; the encroachment of morbid growths; blows upon or wounds of the nerve-trunk; malignant and other tumours of the pelvis; disease of the vertebræ or pelvic bones; the pressure of the gravid uterus; rheumatic or gouty inflammation of the sheath of the sciatic nerve, or of one or other of its branches; syphilitic periostitis, causing a swelling which presses upon the trunk or some branch of the sciatic nerve; and a gumma in the sheath of the nerve.

In chronic rheumatic arthritis of the hip-joint the sciatic nerve may sometimes be felt to have hard, knotty swellings upon it, apparently arising from a chronic peri-neuritis. This is associated with very obstinate sciatica.

Sciatica affects especially the middle age of life—from forty to fifty years, is rare in youth, and but seldom commences in elderly persons.

Venereal excesses have a closer connection with sciatica than with any other form of neuralgia.

The violent manipulation of a professional rubber, employed to treat a dull aching in the sciatic region, may bring about acute sciatica.

Anatomical Characters.—Nothing certain is as yet known of the seat of the lesion in cases of neuralgia proper manifested in the district of the sciatic nerves.

The few changes which have been observed *post mortem* in cases of sciatica have been in the direction of thickening of the sheath of the nerve, the result of inflammation. It has often happened, however, that in cases which during life have been supposed to be examples of neuritis, no trace of the inflammatory process has been found in the nerve or its covering.

Symptoms.—After more or less of vague discomfort in the affected limb, deadness, tingling, stiffness, or some such abnormal sensation, pain occurs in some part of the district already indicated. This is variously spoken of as shooting, darting, screwing, tingling, or burning; and the sufferer will often map out with precision the course of various branches of the nerve as the seat of his distress. Sometimes the leg is described as being numbed, and as if it were going to burst. Occasionally the feeling resembles a very faint shock of a battery. As is characteristic of neuralgia generally, the pain may be apparently spontaneous in origin, whilst in certain cases it is also liable to be aggravated by movement, but in no case is it *only* excited when muscular contraction takes place. It may either occur in paroxysms, with intervals of complete immunity varying from minutes to hours; or there may be more or less continuous suffering, with frequent and violent exacerbations. Throbbings or pulsations of the pain are often described. It is not, as a rule, accompanied by pyrexia. When the pain is at its height, a powerlessness of the muscles of the limbs is apt to be experienced, and this not simply on account of the distress of moving, but from an actual paresis, dependent doubtless upon a depressing influence communicated to the motor centres. From a like cause affecting the vasomotor centres the limb will feel cold, not only subjectively, but to the touch of another.

Tender points may be met with in all, but more often in some few only, of the following situations:—the posterior inferior spine of the ilium; about midway between the tuber ischii and trochanter major; the fold of the buttock; head of the fibula; behind each malleolus; in the popliteal space. There is commonly some cutaneous anæsthesia in some part of the limb, and sometimes replacing this there will be found patches of skin which are hyperalgesic. The tactile sense proper is lowered at these points, whilst the sense of temperature, especially for heat, is often heightened. At the same place a weak voltaic current is felt as extremely and quite abnormally painful. Cramp of the calf muscles is common. It is often impossible for the patient to sit, owing to the tenderness of the nerve-trunk near the tuber ischii. The act of putting on a stocking, stooping, or sneezing gives rise to great pain.

There are great differences in the course and character of the affection. In some persons the disease from the first presents the characters of a chronic affection. There is never pain sufficient, for example, to prevent sleep, and it may not arrive at a degree of severity to interfere much with locomotion. But the patient is worn by a more or less constant aching in the district of the sciatic nerve, which becomes especially marked after long sitting, as on a railway journey, and most of all if the seat is somewhat hard. Fatigue of body and mental worry have great effect, in such cases, in intensifying the symptoms, which, on the other hand, may almost entirely disappear in circumstances favourable to health and mental exhilaration. Sciatica of this type is prone to attack the middle-aged, to be permanent, and to acquire additional intensity with advancing years. In contrast with such cases are those which from the first exhibit the characteristics of an acute affection. The pain is so agonizing that no posture affords relief, sleep is impossible, the general health suffers, and the patient is placed completely *hors de combat*. The disease may last for weeks or months without material intermission, the patient being confined helplessly to his bed. Or after some weeks of acute suffering, improvement may take place, to be followed only by a relapse, which is even more violent than the original attack.

Although the recumbent position is always that which is most grateful to the patient, yet it will happen that after a night passed in sleep attempts to move the affected limb cause it to be more painful than after walking, and there is a distressing stiffness about it.

In some persons the disease attacks once, in a very severe form, it may be at a comparatively early period of life, and never recurs. More often it tends to recurrence, and with such persistence that the patient will speak of 'his sciatica' as a companion which is always present, though occasionally for a term out of sight. Or it may alternate with attacks of typical neuralgia in other parts of the body; or be replaced by various functional disorders of the nervous system, accompanying an excess of uric acid in the urine.

The disease may be accompanied by considerable muscular atrophy of the limb, and a quasi-paralytic condition, which, though capable of improvement, may leave the patient more or less lame for the rest of his life. Or the wasting which has accompanied the acute symptoms of the disease may gradually cease as these subside, and during the somewhat prolonged convalescence the limb may be restored to its original size, and the lameness be no longer observed. Sciatica often follows lumbago. In some cases years may elapse between the attacks, but much more frequently it is a question of a few days or weeks.

Diagnosis.—There are three conditions of the muscular system which are apt to be confounded with sciatica:—1. Myalgia from over-exertion of the flexor muscles at the back of the thigh. Here the pain will be found at the points of insertion of the muscles, and is only felt during their action. 2. Rheumatism in the muscles from exposure to cold. Here again, the pain is not spontaneous, as in sciatic neuralgia, but is always dependent on muscular action. 3. A low

inflammation of the loose bursal tissue which separates the large muscles of the thigh, brought about by the presence of some morbid material conveyed by the lymphatic vessels with which the spaces are in direct communication. Uric acid and pus are especially liable to cause this affection. Sacro-iliac disease may be distinguished by its always occurring in youth; by the pain being confined to the sacral neighbourhood; and by the limb being lengthened at an early period. From hip-joint disease, especially in the slow insidious form which it sometimes takes, sciatica is not always distinguished with facility. The paroxysmal character of the pain, presence of tender points, absence of result from forcible movement of the joint, and absence of characteristic position or shortening of the limb, will best serve for diagnosis. The lameness in sciatica may lead to the idea of paraplegia, from which the disease may be distinguished by the perfect integrity of the other limb, as well as by the paroxysmal pains, tender points, and the history showing that the powerlessness was secondary to the pain. From the darting pains in the thigh consequent on renal calculus, sciatica may be easily distinguished by careful examination.

The affection may be limited to a single branch, and when this is the terminal portion of the anterior tibial nerve supplying the big toe, there is a *primâ facie* resemblance to gout. It may be distinguished from this, however, by noting the absence of heat, swelling, redness, or pain on moving the joint; and the presence of a small spot, at which alone pressure is extremely painful.

Syphilitic periostitis, with inflammation of the sheath of the sciatic, may be distinguished from malignant disease by the effect of large doses of iodide of potassium. Sciatica may be distinguished from the lightning-like pains of locomotor ataxy by the presence of the patellar tendon-reflex. *See* also Lecture by Mr. Hutchinson, *Medical Times and Gazette*, Vol. I. 1882.

Treatment.—This should be constitutional, as well as local. Gout, rheumatism, syphilis, malaria, if inquiry show that either of these conditions lies at the base of the disease, will need the treatment appropriate to each. Against a gouty or rheumatic basis the diet should be spare, and mainly of a vegetable character, with milk—all stimulants being avoided. Bicarbonate of potash in effervescence, citrate of lithia, iodide of potassium, and colchicum will be the drugs most likely to afford relief. If the rheumatic character be very pronounced, it will be well to give salicylate of soda in twenty- or thirty-grain doses, dissolved in half a tumbler of water, every three or four hours. If syphilis be suspected, iodide of potassium or of sodium should be given, in doses of from ten to thirty grains three times a day or oftener.

Quinine, in doses of five grains, may be employed if there be reason to believe that there is a malarious taint.

The recumbent position is very necessary in all cases of any severity; and, should the distress be very great, it is a good plan to put the patient on a water mattress. Warmth is also necessary. Sometimes the rapidly-repeated application of hot linseed poultices will give much relief. Occasionally, if the pain and tenderness be very exquisite, and the patient's age and condition do not counter-indicate it, the application of a few leeches to the upper and back part of the thigh is useful. The hypodermic injection of morphia gives, of all remedies, the most speedy relief. It is best to employ a solution of one grain in thirty minims, and to inject at first three minims twice in the twenty-four hours, if necessary. The dose may be increased by one minim at a time if it be found desirable; but it is rarely necessary, except in cases of malignant disease, to exceed eight minims of such a solution. The dose and frequency should be diminished as relief is obtained. The bowels should be kept thoroughly relieved. Flying blisters, not larger than a five-shilling piece, one following another as it heals, not on the same but on a closely adjoining part of the skin, may usually be applied with much advantage. Even in cases dependent upon malignant disease they will often give relief for a time. Spongiopiline wrung out of boiling water, and sprinkled with the linimentum sinapis compositum, makes a good counter-irritant, and will sometimes take the place of blistering.

The continuous voltaic current is often palliative, and sometimes perhaps curative. From 20 to 40 cells may be employed, and whilst one rheophore is applied to the sacro-iliac synchondrosis, the other is put into a tub of salt water, in which the patient places his foot. The strength should be arrived at gradually, and the application continued for ten minutes at a time. Then, without removing the rheophores, the strength of the current must be gradually reduced to zero. Without this precaution a shock will be given, which is very undesirable. The electrical application should not be employed during the very acute stage, but rather in cases of moderate severity, or where the most formidable suffering has subsided. The current may be conveyed into a bath if preferred. One rheophore is allowed to fall into the bath, the other is held by the patient above the level of the water, which should be of a temperature of 95° Fahrenheit, and should contain some salt. In some cases, after acute symptoms have subsided, good has appeared to be done by enveloping the limb in a flannel bandage, over the folds of which sulphur is sprinkled. In other cases it is said that the spirit of turpentine taken internally has cured where other remedies have failed. In obstinate cases the sheath of the nerve may be punctured in a few places with a sharp needle. *See* Acupuncture.

The baths of Buxton, Wiesbaden, Wildbad, Royat, and Gastein have been found useful in treating sciatica; and artificial hot air or vapour baths may be beneficial in some instances.

The sciatic nerve has been cut down upon and stretched with advantage in several cases of confirmed sciatica. *See* Nerves, Diseases of (3).

T. Buzzard.

**SCIRRHUS** (*σκίρρος*, a hard tumour).—A hard, glandular, cancerous tumour. *See* Tumours.

**SCLEREMA NEONATORUM** (*σκληρὸς*, hard; and *neonatorum*, of the newly-born).—Synon.: Skin-bound disease.

Definition.—A congenital affection, or one appearing in early infancy, characterised by a stretched and tense condition of the skin.

Description.—The disease usually commences on the lower extremities, and gradually involves the entire surface. The skin becomes glossy-looking and of a yellowish or reddish colour, but it may be mottled. To the touch it is firm and rigid, like bacon-rind, and cannot be pinched up between the fingers. The surface is cold, feeling like that of a half-frozen corpse. The infant is, in fact, skin-bound; all movement becomes impossible; and the features remain fixed and staring. Death within a limited period is the ordinary termination, recovery rarely occurring spontaneously.

The disease is usually associated with affections of the respiratory and circulatory systems, and has been observed in connection apparently with congenital syphilis.

Microscopic observation has thrown but little light on the nature of sclerema neonatorum. The subcutaneous tissue has been found to contain a stiff, stearine-like deposit; but the disease seems to differ from the scleroderma of adults in the absence of increased fibrous tissue, which is peculiar to the latter affection.

Treatment.—No treatment appears to avail in this disease, but that for syphilitic taint has been suggested. Alfred Sangster.

**SCLERODERMA** (*σκληρὸς*, hard, and *δέρμα*, the skin).—Definition.—A disease characterised by hardness of the skin.

Ætiology.—The cause of this singular complaint must be regarded as an error of nutrition, or rather a perversion of nutrition. A tissue of low organisation, white fibrous tissue, grows in excess and without restraint; strangles and destroys the more highly organised structures—vessels, nerves, and muscles; and takes the place of the vanished structures, thereby converting a part enjoying active life into an inert, almost bloodless and nerveless cicatricial mass.

Anatomical Characters.—Scleroderma consists in the development and proliferation of white fibrous tissue, and the atrophy, to a greater or less extent, of the more highly organised tissues which enter into the composition of the part. This morbid change is most energetic wherever the white fibrous tissue is most abundant; hence its occupation of the integument and the ligamentous structures of the fingers and joints. And for a similar reason it is apt to follow the sheaths of muscles, and produce consolidation of an entire limb. The newly-formed fibrous tissue is identical with cicatricial tissue, and, like the latter, manifests a disposition to contract, which, in fact, is one of the main features of the disease.

Description.—The integument in this disease is hard, rigid, white, and contracted. On the face the features are distorted by the contraction of the skin; the eyelids are drawn apart; the mouth is pinched in size, or forced open; the neck and limbs are clasped by the morbid skin; the fingers and toes are bent and deformed; and even the bones are forced through ulcerated openings, produced by the pressure of the skin against the ends of the last phalanges or the prominences of the joints.

This is an extreme picture of generalised scleroderma. More frequently the disease is partial, and is limited to certain regions of the body; and most commonly it is met with in the clavicular regions of the trunk. Here it may appear as white blotches, irregular, smooth and shining, dense, and suggesting the appearance of ivory or marble; but at first they may be hyperæmic. Occasionally minute glittering spots may be seen dispersed around, and among these larger blotches. Similar blotches may be found on the trunk and limbs, rarely numerous, and occasionally solitary; the latter are known as *morphæa*. As these blotches sometimes occur in the course of nerves, scleroderma is believed by some to be of neurotic origin.

Diagnosis.—The diagnosis of scleroderma is embodied in the preceding description; the parts affected are hard, rigid, white, smooth or wrinkled, and distorted or deformed.

Prognosis.—The prognosis of scleroderma is highly unsatisfactory. Parts of small extent have been known to recover their healthy texture and function; even when extensive, the disease has been known to improve; but, in general, it must be regarded as incurable.

Treatment.—In the treatment of scleroderma, the whole of our tonic measures, both in diet and drugs, must be brought into use—quinine, iron, phosphorus, strychnia, arsenic, cod-liver oil, and so forth. As a local stimulant, electricity has been employed, apparently with some beneficial result. But as yet the treatment of scleroderma is as essentially unsatisfactory as its cause is difficult to determine.

Erasmus Wilson.

**SCLEROMA** (*σκληρὸς*, hard).—A term signifying a hardening of the softer tissues of the body under the influence of disease. *See* Sclerema Neonatorum; Scleroderma; and Sclerosis.

**SCLEROSIS** (*σκληρὸς*, hard).—Synon.: Fr. *Sclérose*; Ger. *Sclerosis*.

Definition.—A state of induration, hardness, or toughness. The term is also applied to the process by which such a state is brought about in organs and tissues.

Induration of organs has long been recognised, and before the microscope came into ordinary use, this term, as well as its correlative, 'softening,' was very commonly employed by pathologists in their descriptions of certain morbid conditions found in different organs of the body.

Since Laennec, under the influence of a mistaken impression, first gave the name 'cirrhosis of the liver' to one of the common diseases of that organ, it has gradually become more and more common to apply this name, cirrhosis, to analogous conditions of induration in other organs; hence the word 'cirrhosis,' and the phrase 'cirrhotic process,' have come to be used as the equivalents of 'induration,' and 'process of induration,' although the Greek word from which cirrhosis is derived (*κιρρὸς*, yellow, or tawny), has a totally different signification. *See* Cirrhosis.

In recent times a limitation in the use of this phrase has sprung up. The real nature of indurations of organs of the central nervous system,

as well as the frequency of such processes, were recognised much later than the period above referred to. Yet if we make allowance for the peculiarities in the texture of the brain and spinal cord, and remember that even its connective tissue (neuroglia) has a modified constitution as compared with that of other organs, it is evident that these indurations of brain and spinal cord are due to so-called 'cirrhotic processes.' Such processes, in fact, occur in them with great frequency, and constitute the anatomical basis of several distinct diseases. Only it so happens that the old and etymologically unsuitable name has never been applied to them. It has always been common to speak of such an indurating process, as it occurs in the brain or in the spinal cord, by a word of similar import derived from the Greek language—that is, as a 'sclerosing process,' and of the pathological state itself as one of 'sclerosis.' The subject will be found fully treated of in other parts of this work. *See* INSANITY, Morbid Histology of; and SPINAL CORD, Special Diseases of.

H. CHARLTON BASTIAN.

**SCLEROSIS, Cerebro-Spinal**
**SCLEROSIS, Spinal** } *See* SPINAL CORD, Special Diseases of. *Disseminated or Multilocular Sclerosis.*

**SCLEROSTOMA** (σκληρὸς, hard, and στόμα, a mouth).—A genus of strongyloid parasites in which may be placed the species of human nematode sometimes called *strongylus quadridentatus* after Siebold, *dochmius duodenalis* after Leuckart, or, more commonly, *anchylostomum duodenale*, after Dubini, Diesing, and other helmintholo-

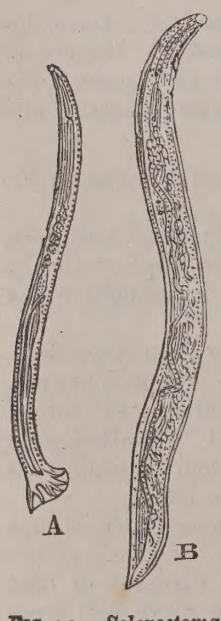


FIG. 73.—*Sclerostoma duodenale*; male (A), and female (B) × 5 diameters.

gists. This helminth gives rise to a special form of tropical anæmia which is not uncommon in Brazil, where it is designated *oppilação*, or *cançaço*. As in Europe the parasite is most frequently called the *Anchylostomum*, so also the disease occasioned by its presence is often called *Anchylostomosis*. Without doubt C. von Siebold's nomenclature is the best, zoologically speaking; but it has been found more convenient to treat of the parasite and its disease in this place.

DESCRIPTION.—The male parasite measures about one-third of an inch in length, the female being very nearly half an inch. The Hunterian Museum contains specimens of this entozoon contributed by Dr. J. F. da Silva Lima, of Bahia.

SYMPTOMS AND DIAGNOSIS.—In persons affected with this disease, according to the late Dr. Wucherer, there is extreme pallor of the visible mucous membranes, with excessive weakness, dyspnœa, palpitation, and a tendency to syncope. Dropsical effusions supervene, and death sometimes follows from dysentery and diarrhœa; but the loss of blood consequent upon the suction-wounds of the sclerostomes is the real cause of the malady, whether the attacks prove fatal or not. When the symptoms just mentioned occur in any person resident in a warm country, the presence of these parasites will naturally be suspected. In such cases anthelmintics should be administered, followed by a careful inspection of the fæces, in which the worms or their ova may be found.

HISTORY.—The worm was first discovered by Dubini at Milan, and seems to be tolerably common throughout Northern Italy; but, according to Pruner, Bilharz, and Griesinger, it is still more abundant in Egypt. The 'Egyptian chlorosis,' as the disorder is also sometimes termed, has been described in the standard works of Küchenmeister and Davaine, and also, with great care, by Leuckart (*Die Mensch. Par.*, s. 455 *et seq.*), who closely follows Griesinger (*Archiv f. physiol. Heilk.*, 1854). The writer has carefully gone over the late Dr. Wucherer's admirable memoir on this subject, and only refrains from quoting his statements at greater length from want of space ('Ueber die Anchylostomumkrankheit, tropische Chlorose, oder tropische Hypoämie,' *Deutsches Archiv für Klin. Med.*, 1872, ss. 379–400). The estimable author not only supplied the writer with abundant materials for confirming what others had already made out respecting the structure of this worm (*Entozoa*, p. 361); but he supplied the specimens which formed the subject of the excellent illustrations given by Dr. Weber in the *Path. Soc. Trans.* for 1867 (vol. xviii., p. 274). Numerous prior observations made by Wucherer in the *Gazeta Medica da Bahia* are included in the memoir above quoted, and they have been referred to in the writer's recent work (*Parasites*, 1879, p. 213 *et seq.*). When Wucherer announced, through Dr. Jobini at the Rio Academy, his discovery of the Egyptian chlorosis in Brazil, his views as to the true cause of the disorder met with opposition. The general opinion was that the *Anchylostomata* were not the primary and necessary cause of this tropical anæmia, but rather a co-operating agent in its production. Against this view Dr. Wucherer afterwards very properly protested (*Gazeta*, January 15, 1868). In the meantime, says Wucherer, 'Dr. Le Roy de Mericourt, prompted by my first communication, had invited the physicians of the French colonies to seek for anchylostomes. Drs. Monester and Grenet, at Mayotta (which lies about 12° S. lat. to the north-east of Madagascar), ascertained the presence of entozoa in hypoæmics. Dr. Grenet sent the duodenum and a portion of the jejunum of an hypoæmic corpse to Le Roy de Mericourt, who compared the anchylostomes with Davaine's description, and recognised them as examples of *A. duodenale*. In the year 1868 Dr. Rion Kérangel found anchylostomes in the bodies of hypoæmics in Cayenne. Thus (adds Wucherer) the occurrence of anchylostomes in hypoæmics has been authenticated by Pruner, Bilharz, and Griesinger, in Egypt; by myself, Dr. Moura, Dr. Turinho, and other physicians, in Brazil; by Monestier and Grenet, in Comorens; and by Rion Kérangel in Cayenne. It thus also appears, from the wide separation of these several localities, that the anchylostomes, if duly sought for, will be found in many

other countries.' Dr. Wucherer was correct; and what has since been unwisely called *Tunnel Trichinosis* is merely another name for the same disease, which recently caused so much havoc among the workmen in the St. Gothard tunnel. This outbreak was specially investigated by Professor Perroncito, of Turin, and by Dr. Bugnion of Geneva. The memoir by Perroncito (*Osserv. Elmint. relative alla Malattia sviluppatasi endemica*—R. Accad. dei Lincei, 1879-80), is illustrated with figures of the larval anchylostomes. Figures of the adult worm are given by Bugnion in his memoir, with a valuable bibliography (*Revue Méd. de la Suisse Romande*, May and June 1881). More recently Dr. Perroncito has communicated to the Académie des Sciences his observations on a like outbreak amongst the miners of St. Etienne.

Treatment.—Perroncito gives the following excellent advice as to treatment:—'The strength should be sustained with food easy of digestion, very nourishing, aided by the best tonics and reconstituents, whilst we proceed at the same time to destroy the worms which constitute the fundamental cause of the oligæmia. None of the patients subjected to treatment with the best anthelmintics, with a good meat diet and rich wine, need succumb, unless the anæmia has arrived at that extreme degree in which the organic powers cease to regenerate the blood; and still less, if at the same time they take preparations of iron and bitters.' He adds: 'The ethereal extract of male fern appears to me most adapted to kill the different species of parasites; only it must not be supposed that one or two doses will be sufficient to liberate the intestines from thousands and perhaps millions of helminths that live on chyle and blood.' Prof. Perroncito mentions the case of a young St. Gothard patient, with large quantities of anchylostomes, combined with not a few anguillulæ and some ascarides, who was treated with male fern so successfully that even the 'first draught' occasioned great relief. This was followed by santonine and the nourishing diet above recommended. The patient's strength rapidly increased, and he was afterwards perfectly restored to health. In many other cases under Perroncito's care the same excellent results followed. This success has been acknowledged by Dr. Bugnion in his admirable paper published in the *Brit. Med. Jour.* for March 12, 1881. Like Wucherer, Dr. Perroncito had to encounter much opposition. The tunnel disease was referred by his opponents to any cause rather than the true one. At length, says Dr. Bugnion, the parasitic character of the malady was irresistibly recognised when 'Dr. Sonderegger had treated a young engineer of the works. The patient showed all the symptoms of Egyptian chlorosis; and after having taken santonine with calomel, evacuated the anchylostomes in large numbers.' The writer has encountered similar opposition in respect of certain destructive animal epidemics, which he has found to be caused by strongyloid and other parasites. Further confirmation of the truth of Perroncito's determinations was afforded by cases under the care of Professor Bäumler, Dr. Schönbochler, and Dr. Damur respectively. Particulars of these cases are given by Dr. Bugnion, who also concludes his interesting paper by the surprising statement that 'in the report published in June 1880 by Dr. Sonderegger, who was retained by the Federal Government, of the bodies in 117 cases of death only a single examination was made. The conduct of the authorities of Airolo in refusing the necessary *post-mortem* inspections was certainly most reprehensible.

T. S. Cobbold.

**SCLEROTIC, Diseases of.** *See* Eye and its Appendages, Diseases of.

**SCORBUTUS.**—A synonym for scurvy. *See* Scurvy.

**SCRIVENER'S PALSY.**—A synonym for writer's cramp. *See* Writer's Cramp.

**SCROFULA** (*scrofa*, a sow).—Synon.: Fr. *Scrofule*; Ger. *Scrofeln*.—If we would raise the true doctrine of scrofula we must build upon the foundations of the ancients. The Hippocratic choirades (χοιράδες), *struma vera*, or glandular scrofula, should ever be the criterion or note of what is scrofulous. Guided by this principle, we may extend the use of the word scrofula far beyond its ancient limits, without any fear lest the meaning of the term should become proportionally vague and indefinite. In the first place, struma vera will be to us the sign of a present and antecedent strumous diathesis, or special disposition to this form of disease. In the next place, upon the strumous diathesis, thus signified, will be found to depend many forms of disease other than glandular. And for this very reason, because the meaning of the word scrofula can be thus widened, it becomes highly important that the criterion, note, or principle itself should be well defined and understood.

**I. Struma Vera: Scrofulous Lymphatic Glands.**

Anatomical Characters.—Matthew Baillie writes thus: 'The most common morbid affection of the absorbent glands is scrofula. In this case the glands are frequently a good deal enlarged, and sometimes feel a little softer to the touch than in a healthy state. When cut into, they sometimes exhibit very much the natural appearance; but it is more common to find that some of them contain a white, soft, cheesy matter, mixed with a thick pus: this is the most decided mark of a scrofulous affection.'

But this cheesy change is a late stage of the strumous affection. Scrofulous glands, which are only potentially, but not actually, cheesy, present to the naked eye very much the natural appearance, as Baillie says. If we take a chain of lymphatic glands, all somewhat enlarged, but only some of them cheesy, we should expect to find the earlier stage of the strumous lesion in the glands which look most natural. These apparently natural lymphatic glands, therefore, are those which we choose for examination first of all.

Virchow taught that the primitive strumous lesion consisted in a simple hyperplasia of the gland-tissue. But to Schüppel (1871) belongs the merit of having proved that a scrofulous gland is indeed a tuberculous gland. In the earlier stage of the lesion, the gland is studded

with microscopic tubercles, possessing characters described in the article on tubercle. And the subsequent changes, cheesy and other, which the gland undergoes, are due to changes in the tubercles. (See *Scrofula* by Mr. Treves, Lond. 1882.)

Symptoms.—In the living person strumous lymphadenitis may be distinguished from what we may call genuine lymphadenitis. The first character of the scrofulous disease consists in an excessive irritability or inflammability of the glands, constituting what Thomas White long ago called an 'inflammable diathesis.' Vulnerability is a word employed by Virchow to signify the same peculiarity, which may assume two forms: namely (i.) that the inflammation is much greater in a scrofulous person than in a healthy person, under the same conditions; and (ii.) that glands, which in a person not scrofulous, would not inflame at all under the circumstances, in a strumous person do inflame. Another character of the scrofulous disease consists in its obstinacy, intractability, pertinacity. Once enlarged, the strumous gland remains enlarged for a long time. The reason of this lies in the nature of the scrofulous inflammation and its products. A genuine lymphadenitis, in a healthy person, will resolve, suppurate, or organise in a short time. In struma vera, resolution, suppuration, and organisation take place very slowly, even when they take place at all. Commonly the inflammatory products remain, where they were produced, inert and passive, and sooner or later undergo the cheesy change. Hence the intractability of strumous lymphadenitis.

II. **Antecedent Scrofulous Lesions.**—Lymphatic glands do not enlarge spontaneously. There is always some antecedent lesion which sets up a change, similar to itself, in the associated glands. Of all tissues of the body, the lymphatic is the most embryonic, the least differentiated or organised. For this reason it is also the most plastic of all tissues, and endowed with most potentiality. A venereal sore causes a venereal bubo, cancer causes cancer, and so forth. Let us inquire into the characters of the lesions which precede and cause the strumous or tuberculous lymphadenitis.

In general, these primitive lesions are also inflammatory. And inflammations being commonly the result of injury, we might expect these primitive inflammations to be usually seated in those parts of the body which are most directly subject to injury. Such is the case. The skin, the mucous membranes, the subcutaneous connective tissue, the bones, and the joints are the most frequent seats of the original scrofulous disease. Occasionally the primitive lesion affects the solid secreting glands, especially the kidneys and the testicles.

The distinguishing characters of these primitive lesions are those common to all strumous inflammations, and those peculiar to the special inflammation. 1. The common characters of scrofulous inflammation have already been partly enumerated with respect to the lymphatic glands. Functionally, vulnerability and obstinacy mark the primary as well as the secondary lesions. Structurally, the chief peculiarities are found in the inflammatory product. This, when fresh, is rich in cells, which are much larger than the corpuscles of a genuine exudation, and which consist of a dim glistening protoplasma, and a large nucleus, either single or double; in short, epithelioid cells. Scrofulous exudation is either infiltrated, diffused, and assuming no particular shape; or it is tubercular. And lastly, it is rebellious, and resolves, suppurates, or organises slowly and imperfectly. The defective vascularity of strumous products will account in part for these peculiarities. 2. The special characters of scrofulous inflammations can only briefly be alluded to. In the skin, the most characteristic lesions are those which the French school have called *scrofulides*. The common dermatitis, or eczema, is modified when it occurs in a scrofulous person: eczema impetiginodes, in particular, often shows the characters of vulnerability, obstinacy, and recidivity, and of an exudation rich in cells. Impetigo of the eyelashes (tinea tarsi), and otitis externa are common strumous diseases. In the mucous membranes scrofulous inflammations possess similar characters. The secretion is sticky, rich in cells, and tending to form scabs. The mucosa, according to Rindfleisch, is infiltrated with an exudation, sometimes so copious that the corpuscles form a complete layer beneath the epithelium, and reach deeply into the submucosa. Actual tubercles may form, and intractable ulceration may follow upon the exudation, whether diffused or tubercular. Ophthalmia, coryza, ozæna, angina faucium, otitis interna, laryngitis, bronchitis, enteritis, pyelitis, cystitis, vaginal and vulvar catarrh, are common forms of strumous inflammation of mucous membranes. In the connective tissue scrofulous disease possesses the same characters, which need not be narrated again; slow cold abscesses, which will neither discharge nor disperse. Besides abscesses, local exudations, which are equally obstinate, but which go no further than a chronic œdema or induration, are often present in the subcutaneous tissue of scrofulous persons; the lips and eyelids are affected thus with especial frequency. Scrofulous arthritis, osteitis, and periostitis are described under their appropriate articles. Lastly, the lungs, kidneys, and testicles may be the seat of primitive strumous disease.

III. **Tertiary Scrofula.**—We have traced struma backwards from the secondary lymphadenitis to the primary lesion. We must now assert that scrofulous disease may be disseminated over the whole body, in a manner precisely similar to the dissemination of cancer in its last stage. This disseminated or tertiary scrofula is nothing else than general tuberculosis. The tubercular dyscrasia, approached from our present point of view, is tertiary scrofula. *See* Tubercle.

IV. **The Scrofulous Diathesis.**—Strumous lesions imply the existence of a strumous diathesis, or special disposition to strumous disease. Upon this topic we will ask three questions: How may the strumous diathesis be recognised? What is the strumous diathesis in itself? and What are its causes?

1. The strumous diathesis may be detected in two ways—directly or indirectly; it may be manifested by the patient himself or by his kindred. The latter or indirect means of discovering

scrofula depends upon a fact in ætiology, to wit, the strongly hereditary nature of this diathesis.

i. Struma manifests itself in the patient himself, in the first place, by means of the characteristic lesions which have been already enumerated; and secondly, by means of the phlegmatic temperament. Now the doctrine of temperaments, however true we may feel it to be, seems to lie beyond the power of exact definition. With regard to the phlegmatic or lymphatic temperament more particularly, we may say that its chief characters seem to consist, structurally, in a defect of blood, and an excess of serum, lymph, or phlegm; and functionally, in languor. But although scrofula is especially common in the phlegmatic temperament, the phlegmatic temperament does not necessarily imply scrofula; and, moreover, scrofula may be met with in sanguineous and melancholic temperaments. So that, as was afore said, it is not possible to lay down any definite rule upon this topic.

ii. Struma, manifesting itself in the kindred of a person, may be deemed a proof that the person akin possesses the same diathesis. In the first place, his kindred may be known to have suffered from strumous diseases. In the next place, a great mortality in the family would probably be due to the strumous diathesis, since no other diathesis can compare with it in highly hereditary character, and in the large number of dependent fatal lesions, occurring at all ages.

2. Of the intimate nature of scrofula we know very little. When we ask what that property is which serves as bond of union between the diathesis and its manifestations, and between those manifestations among themselves, we cannot say more than that scrofula is a special form of constitutional weakness, debility, or degeneracy of mankind. We do not know what determines the special form, nor what are the relations between struma and other degenerate habits, such as bronchocele, leprosy, cancer. The scrofulous debility or defective vitality manifests itself chiefly in two ways. First, in a defective power of resistance to external influences; hence the vulnerability of strumous persons. Next, in a defective power of growth and development; a defect which shows itself not only in the inflammatory process (constituting obstinacy, intractability), but also in the delayed or defective growth of some or all parts of the body. This opens up the whole topic of malformations, congenital idiocy, delayed developments; but at present experience hardly carries us any further.

3. Ætiology is another weak part of the doctrine of scrofula. In this place it is not possible, and under any circumstances it would hardly be profitable, to do more than set down a few general propositions. Whatever lessens health and strength tends to beget scrofula; and tends to beget it, not so much in the enfeebled person himself, as in his offspring. Once produced, struma is highly hereditary. The latter two propositions, taken together, express the fact that the scrofulous diathesis is commonly congenital. Among the anti-hygienic conditions in the parent, which tend to manifest themselves as scrofula in the child, must be mentioned constitutional syphilis, and the age of the parents at the time of conception, either too advanced or too youthful. Congenital scrofula does not often show itself during the first year of life. From the second year onwards, during the whole period of growth and development, strumous diseases are very common. After middle life they become less common; yet a strumous person may manifest his diathesis even in extreme old age.

Treatment.—The treatment of scrofula is preventive and curative; and relates, moreover, to the strumous disposition and the dependent structural lesions. The prevention of the disposition clearly consists in avoiding the predisposing and exciting causes thereof. Its cure is to be sought in carrying out the rules of health: fresh air and sunlight are especially needful (*see* Personal Health). Iodine, once thought to be a specific, has much sunk in repute; cod-liver oil ought perhaps to be reckoned food rather than a drug. The cure of the local lesions does not only relate to the sundry lesions themselves, but is also a means of preventing further development of the disease. Cure and prevention thus go hand in hand. The treatment of the primary local inflammations will be found in the appropriate articles. With regard to the glandular abscesses and phlegmonous scrofulides—the chief sources of general tubercular infection—it would seem to be more reasonable to favour an outward discharge of the matter, than to strive to promote its absorption. Scrofulous bones have been removed with the same intention.

S. J. Gee.

**SCURF.**—A popular name for the furfur or bran-like exfoliation which forms at the roots of the hair. It is also called *dandruff*. It is composed of the normal desquamation of the epidermis of the scalp, with the addition of the epithelial exuviæ thrown off by the hair-follicles. *See* Pityriasis.

**SCURVY.**—Synon.: Scorbutus; Fr. *Scorbut*; Ger. *Scharbock*.

Definition.—Scurvy is characterised clinically by intense general debility; sponginess and swelling of the gums; ecchymoses, closely resembling bruises, about the thighs and legs; a brawny hardness about, and sometimes a contraction of, the muscles of the calf; pearly conjunctivæ; and a sallow aspect somewhat akin to mild jaundice.

From a pathological point of view the disease is characterised by effusion of a semi-organisable fibrinous material in the tissues of the gums, between the striæ of the muscles of the thighs, legs, and sometimes (but comparatively seldom) of the arms, and also between the periosteum and the bones of the extremities, and occasionally of the ribs; ecchymoses sometimes found about the thoracic and abdominal aortæ and the alimentary canal; and a generally blanched condition of all the tissues.

Ætiology.—Scurvy is, in an eminent degree, cosmopolitan. It may prevail in a mild or severe, an intermittent or endemic form, in any latitude, in any country, or among any variety of the human race, inasmuch as the predisposing and exciting causes may exist anywhere under certain circumstances. War, famine, shipwreck, or any other accident or exigency that deprives

human beings for a length of time of fresh vegetable food, is sufficient to introduce scurvy into a community. Although very vaguely described by Hippocrates and other early writers, there is no doubt that in semi-civilised and savage countries scurvy was endemic. Most military historians, who have chronicled the sanitary circumstances of armies from the thirteenth century to the date of the last American war, speak of its ravages, and in the early months of the Crimean War the French lost more men by scurvy than by the guns of the enemy. It has also from the earliest times been a chief foe to sailors, and until the beginning of the seventeenth century, it constituted a formidable item in the mortality list of the navy, in this as in other countries. In the spring of 1840, an outbreak of the disease occurred among the prisoners at the Millbank Penitentiary, and was confined exclusively to the military sections of the inmates, whose diet differed in one important respect from that of the other convicts. The last extensive outbreak on land, other than those that have arisen in consequence of war, occurred in Ireland during the potato famine in 1847, when the inhabitants suffered severely. Since, however, the prophylactic properties of a vegetable diet have been understood, scurvy, except in times of war, has—unless under very exceptional and always preventable conditions—ceased to assume formidable proportions either ashore or afloat. It is indeed in civilised communities very rarely found on land. It is almost extinct in the Royal Navy, owing to the introduction of lime- and lemon-juice, and also to the greater variety in the scales of diet; and during the last eight years it has diminished in the British Mercantile Marine, by from seventy to eighty per cent., in consequence of legislative enactments that secure a proper quantity and quality of antiscorbutics to the crews of all long-voyage ships. Cases of the disease are still seen occasionally at the Seamen's Hospital at Greenwich, usually associated with some other disease, as dysentery, ague, etc.; but in some instances clearly caused by carelessness, either on the part of the captain in serving, or on the part of the crew in not taking, the lime-juice provided.

Pathology and Anatomical Characters.—Although the ætiology of scurvy is so well understood, yet we are still in ignorance of the precise nature of the alterations of the blood and tissues which precede and accompany the development of the disease. The most important contributions hitherto made to our knowledge of the pathology of scurvy are those of Mr. George Busk and Dr. Garrod. The former, in a series of analyses made of the blood drawn from scorbutic patients, showed that there was a considerable diminution of the red blood-corpuscles, an increase in the amount of fibrin and albumen, and no decrease in the amount of potash salts. Dr. Garrod observed that in scorbutic diets potash existed in smaller quantities than in antiscorbutic ones, and was led to determine the amount of that substance in the blood and urine of a patient suffering from scurvy, and he found it considerably diminished. From this observation, he brought forward the theory that scurvy depended upon a deficiency of potash in the system. The fact that potash is diminished in the urine of patients suffering from scurvy, has been confirmed by Ralfe and others. But it is doubtful whether the disease is produced by a deficiency of that base in the system, since the administration of large quantities of beef-tea, containing more potash than in the ordinary anti-scorbutic dietary of the Seamen's Hospital, fails to exercise a curative effect, and it is not till the patient obtains lime-juice or potato that he recovers. Dr. Buzzard considers that, although the organic acids and potash separately do not represent the requisite material, it is to be found in the chemical combination of the acid and the base. Dr. Ralfe, from observations founded on the effect which the withdrawal, for a considerable period, of all fresh succulent vegetables and fruits has on the urine of healthy persons, and from the analyses of urines from patients suffering from the disease, states that the 'primary alterations in scurvy seem to depend on a general alteration between the various acids, inorganic as well as organic, and the bases found in the blood, by which (*a*) the neutral salts, such as the chlorides, are either increased relatively at the expense of the alkaline salts; or, (*b*) that these alkaline salts are absolutely decreased. This condition produces diminution of the normal alkalinity of the blood, and he suggests that this diminution produces the same results in scurvy patients as happens in animals when attempts are made to reduce the alkalinity of the body (either by injecting acids into the blood or feeding with acid salts), namely, dissolution of the blood-corpuscles, ecchymoses and blood-stains on mucous surfaces, and fatty degeneration of the muscles of the heart, the muscles generally, and the secreting cells of the liver and kidney.'

The most marked morbid changes of scurvy are the œdematous, spongy, and occasionally ulcerated gums; the bruised-like condition of the legs; and the brawny hardness, confined usually to the gastrocnemius and hamstring muscles. On cutting these across, tough fibrinous effusions are found packed between the muscular striæ, giving the cut surface a streaky appearance. If the anterior surface of the tibia be examined, the same kind of effusion will be often found between the periosteum and the bone. It would appear that the effusion is due, not to the degenerated condition of the vessels, but to a chemical alteration of the blood.

In severe cases the ribs will sometimes be found detached from the cartilages, and old fractures occasionally become disunited. Beyond a general anæmic condition, and occasional ecchymotic spots about the pleura and pericardium, the contents of the thorax present no special appearances. In examining the abdominal viscera, attention should be directed to the spleen, which is usually friable, and often rotten and pulpy; to the external coats of the intestines, in which patches of effusion will frequently be found; and to the mucous coat of the large intestine, which if, as is frequently the case, the disease be complicated with dysentery, will be studded with ulcers of varying depth, which have, however, entirely lost their dysenteric character, and become

ragged along the edges, ill-defined, but not, as a rule, very much excavated. The body is not always badly nourished, and the cheeks are usually puffy on account of the swollen gums, but local or general dropsy is seldom present.

Symptoms.—The most striking features of scurvy are a complexion of sallow, dull, leaden hue, analogous only to that of a patient who has been for a long time subject to attacks of some form of remittent or intermittent fever, or to that of a person recovering from jaundice; pearly-white conjunctivæ; puffy and sometimes bloated cheeks; gums spongy, bluish-red in colour, swollen sometimes to such an extent as to hide the teeth both in front and behind, and tending to bleed; teeth more or less loose, some already lost; tongue clean and pale; no special characteristic about trunk and upper limbs (though the latter are now and then slightly ecchymosed); shortness of breath, but no other chest-complication; no abdominal tenderness or anything abnormal as to the functions of the abdominal organs; thighs and legs usually presenting a more or less bruised appearance, particularly just above and below the knee; brawny indurations of the hams and calves of the legs, often painful and tender; and the effusions above described may be so dense and abundant as to fix the legs in a semi-flexed position. Node-like swellings are also often observed over the tibia, owing to effusions between the periosteum and the bone. There are also usually a large number of spots and patches, very much like those of purpura, scattered indifferently about the lower limbs. There is sometimes considerable œdema about the ankles; but in uncomplicated scurvy, pitting on pressure anywhere is the exception rather than the rule. The bowels are more or less constipated, appetite is good, and there is no thirst. The breath has a peculiar offensive odour, and this may be aggravated by ulceration or sloughing of the gums, or necrosis of the jaw. General debility varies in degree, but may be excessive, with weak voice, and some tendency to fainting, if the patient is put or kept in a sitting position. He feels more or less general aching, and a sensation of contusion in the legs. The skin is dry and harsh, and desquamates over the legs. Heart and lung sounds are normal. The urine is free from albumin, of normal specific gravity, with abundant chlorides; urea, phosphates, and potash are said to be deficient.

Complications and Sequelæ.—Simple scurvy is now rarely seen inland (except in times of war or famine), and not very often afloat. It still, however, complicates diseases or accidents that occur at sea to a considerable extent, and so prolongs convalescence almost indefinitely. A sailor, for example, goes out from England to Calcutta, and shortly after arrival in the latter port is attacked with dysentery or intermittent fever, fractures a limb, or becomes syphilitic. He remains in India a very short time, ships in a convalescent and enfeebled condition, lies up before the ship has been at sea many days, and probably does little or no work during the entire passage. The berth that he occupies constantly (and with very little change of clothing) is probably wet, his food scanty and unvaried, and his lime-juice or other antiscorbutics (as he cannot go to fetch them) served out irregularly, or perhaps refused when given. Under such circumstances, scurvy soon begins to 'colour' the original disease. The intestinal canal in cases of dysentery, the spleen in cases of ague, buboes and chancres in syphilis, are all attacked, so to speak, scorbutically. Wounds, scratches, ulcers, or any other breaches of surface will not heal, and fractures sometimes become disunited; so that, as a consequence, the recovery of the patient after his arrival is deferred (solely on account of the existence of this scorbutic condition) for several weeks or months. In fact, all processes of repair, internally and externally, appear to be arrested, and no advance is made until the scorbutic symptoms have entirely disappeared. Hemeralopia is sometimes associated with scurvy, and it may be considered that night-blindness is induced by scorbutic conditions, inasmuch as this affection has decreased *pari passu* as scurvy has diminished in the British Mercantile Marine, and is now seldom complained of by sailors. In bad cases hæmorrhage may take place from mucous surfaces. Nausea and vomiting may also occur.

The sequelæ of uncomplicated scurvy are, practically speaking, *nil*, for the patient, when properly treated, makes a rapid and complete recovery, leaving no trace of the disease behind. There appears, however, to be little doubt that one illness renders the patient less able to resist successfully future attacks of the disease, if placed under the same predisposing conditions. Several instances are recorded of old sailors, who have been the subjects of two or three attacks; but these have been generally complicated with some other disorder, delirium tremens being occasionally superadded.

Diagnosis.—The diagnosis of scurvy cannot be difficult if the symptoms described above exist, and a dietetic history is carefully made out. As Parkes records, in a very valuable paper published on that subject in the second volume of the *British and Foreign Medico-Chirurgical Review*, 'it may be confidently asserted that an invariable antecedent of every case of scurvy is a deficiency or absolute want of fresh vegetable food.' This important item of information being established, the spongy gums, and the bruised-like condition of the lower limbs (this latter condition not being connected with any history of accident or injury), with great general debility, should be sufficient to determine the nature of the disease. For even in mild cases the condition of the gums is quite unlike that produced by mercury. Moreover, the mercurial fœtor is absent, but a fœtid, earthy odour exists. Nor has the dull blue margin seen in the gums in cases of lead-poisoning any resemblance to the scorbutic condition. Scurvy might be occasionally confounded with purpura, as in some cases hæmorrhagic spots only exist about the legs, with no ecchymoses or hardness round the calf and hamstring muscles. But the condition of the mouth, the absence of severe cachexia, and, as Niemeyer remarks, the comparative absence of epistaxis, hæmatemesis, hæmatoma, and bloody evacuations from the bowels in scurvy, will aid at once to settle the diagnosis. The disease is now, under ordinary circumstances, rare among women and children. The

possibility of its existence should not, however, be overlooked. Dr. H. G. Sutton read at the Clinical Society, in 1871, notes of two cases of acute scurvy in women, but no particulars as to dietetics are given. Dr. Dickinson had under his care at the Children's Hospital, Great Ormond Street, a girl, ten years of age, who was the subject of genuine uncomplicated scurvy, whose diet had for some months consisted chiefly of bread and butter, with no meat, and little or no milk. Single cases are also occasionally noted by physicians, caused for the most part by pursuing strictly a scorbutic regimen, for the purpose of combating some other obstinate disorder.

Prognosis.—Scurvy existing apart from other maladies is not a fatal disease. The patient may be seen in a state of excessive prostration, with feeble pulse, whispering voice, and a tendency to syncope, unless the recumbent position be rigorously maintained; but a few days' rest, under favourable conditions, and proper treatment, produce a marvellous change, which results in a steady and very satisfactory convalescence. But before this prognosis is given, care should be taken to ascertain that the scurvy does not cover any other chronic or organic disease. Dysentery, syphilis, and the various forms of intermittent fever, are undoubtedly its worst complications, and either of these maladies will, even under favourable circumstances, prolong convalescence considerably. The duration of the disease is limited only by the vitality of the causes that produce it, for as long as the scorbutic diet and other predisposing conditions exist, so long will the disease maintain the mastery, and progressively increase in severity. M. Villemin, writing on the causes and nature of scurvy, in the *Gazette des Hôpitaux*, 1874, says, as the result of experiences gleaned during the siege of Paris, that scurvy is a contagious disease, and should be classed with typhus. It is impossible, in face of facts recorded both as to sea and land scurvy, to subscribe to this opinion, and it is difficult to understand on what grounds such a dictum can be based.

Treatment.—If the patient, when first brought under notice, be so ill as to be unable to walk or stand, great care should be taken that the recumbent position is adopted and maintained. Many severe cases of scurvy have been lost by the neglect of this apparently simple precaution. The patient, in the absence of the nurse, sits up in bed, and has a sudden attack of syncope, from which he never recovers. Having regard to this, let the patient be undressed carefully, and washed (without a bath), any wounds or abrasions being covered with simple water-dressing. The direct treatment of the disease is almost purely dietetic, starting upon the principle that want of fresh vegetable diet has been the exciting cause of the illness. So the diet should consist of mashed potatoes; any variety of green meat (the *Cruciferæ* being perhaps the best); oranges, pears, apples; and, as a convenient antiscorbutic, lime- or lemon-juice at the rate of from three to four ounces daily, mixed with about eight times its bulk of water, sweetened to taste, and used as a drink. Solid animal food should be given at least once a day, and in liberal quantity, as soon as it can be properly masticated. Begin in bad cases with beef tea, mutton broth, milk, eggs, fish and minced meat, in fact, any and all varieties of nutritious animal food, in conjunction with the vegetable diet; for the appetite is usually good, and the digestive powers almost unimpaired. If great prostration exist, brandy, in small and frequent doses, must of course be given; but as a general rule, very little is required. Malt liquors are undoubtedly antiscorbutic, and it is well to give a pint of ale or porter daily if no dysenteric complication exist. Milk is also to a certain extent antiscorbutic, and should be given freely. Sir James Paget relates of a surgeon that he lived for nineteen years, engaged in active practice, on milk and breadstuffs exclusively, and at the end of that time only was attacked with scurvy. As regards therapeutics, little or nothing need be done All active treatment, general and local, is emphatically wrong. The administration of mercury to scorbutic patients (through errors of diagnosis) did, in former years, an enormous amount of mischief, and, even in the presence of chest-complications, all counter-irritants to the skin must be avoided. Chlorate of potash, in the form of a mouth-wash, or given internally, probably assists to cleanse and purify the gums and mouth; and if old ulcers or open sores exist upon any part of the body, lint, wetted with weak lime-juice, is said to promote a healthy surface. But whether any complication be internal or external, no processes of elimination or repair will advance satisfactorily until the scorbutic symptoms disappear. If no grave disorder beyond the scurvy exist, recovery is very rapid, and few diseases are so eminently satisfactory to treat. The gum-swellings recede, and the ecchymoses on the legs begin to disappear after two or three days of treatment; and the brawny tenderness of the muscles of the lower limbs diminishes daily, the fibrinous effusions causing it being steadily and quickly absorbed. Dysentery is the most common complication of scurvy, and is usually tedious and troublesome. A fair trial should be given to the treatment above recommended, excluding malt liquors, and substituting a small allowance of brandy, and as a rule the dysentery and scurvy will disappear together.

The antiscorbutic treatment proper to combat the advent of this disease is sufficiently indicated in the above remarks, for it will be plainly seen that scurvy is due to the absence of certain necessary ingredients in diet. When these ingredients cannot be given in the usual form, the most convenient substitutes are lime-juice, lemon-juice, and in a minor degree citric acid. Garrod recommends salts of potash, and John Morgan, of Dublin, thinks that phosphorus is deficient where scurvy exists. But the great mass of evidence, collected during the last fifty years, goes to prove that lime- and lemon-juice contain, in natural combination, the best and most convenient prophylactic elements against scurvy. Its use in the Royal Navy has, since the close of the last century, been chiefly instrumental in driving the disease out of the service; and legislative enactments passed in 1867, whereby a proper and genuine supply of juice was secured to all British sailors, have resulted in the decrease

of scurvy in our own Mercantile Marine by from 70 to 80 per cent. Single cases are, of course, occasionally met with afloat, for the disease, although almost entirely preventible, will never be practically exterminated from the merchant navy until legislators, ship-owners, and ship-masters are convinced that it is commercial economy to send to sea only healthy men. Scurvy will, of course, always be liable to occur in times of war and famine; and among any class of the population the possibility of its existence in single cases, in consequence of dietetic deficiencies, should never be overlooked.

HARRY LEACH.

**SCYBALA** (*σκύβαλον*, dung).—Fæces in the form of hard rounded lumps, whether discharged or retained in the intestine. *See* FÆCES, Examination of.

**SEA-AIR; SEA-BATHS; SEA-VOYAGES.**—The physiological and therapeutical effects of sea-bathing cannot be separated from those of sea-air; for it is impossible to take sea-baths without being under the influence of sea-air; and the stay at the seaside alone, without sea-bathing, produces on many constitutions all the effects which are usually ascribed to sea-bathing. Residence at the seaside, that is, the influence of sea-air, is to be regarded as a special kind of climatic treatment, while the action of the sea-bath is analogous to the stimulating forms of the cold-water treatment.

As the sea-air and the sea-bath owe part of their properties to the constitution of sea-water, it will be well to begin with the latter, then consider the characters and influences of the sea-air and the sea-bath, and add some notes on seaside watering-places, and on sea-voyages.

**Sea-water.**—*Temperature.*—The sea-water is of more equable temperature than the surrounding air. It is, as a rule, warmer than the atmosphere in winter, and cooler in summer; although on chilly days in summer, especially after a series of hot ones, the temperature of the sea-water is often higher than that of the air. The variations of the temperature of sea-water from night to day, and from one day to another, are much less than those of the air. It would, however, be erroneous to assume, as is sometimes done, that the temperature of the sea-water near the shore is the same at different times of the day. The writer has often measured it at the Riviera, and the south coast of England, and has repeatedly found it, at one P.M. and two P.M., from 5° to 7° Fahr. higher than on the corresponding mornings at seven or eight A.M. As to the different seasons, the sea-water reaches its highest temperature in summer much later than the air; and as it loses its heat less rapidly than the latter, it is mostly warmer in autumn and winter than the surrounding air, and gives off warmth to the latter. During the sea-bathing season, namely, from the end of May to the beginning of October, the temperature of the sea-water at the coasts of England, the north of France, Belgium, Holland, and Germany, varies in general from about 56° to 72° Fahr., while in the Bay of Biscay and in the Mediterranean it is considerably higher.

*Constituents.*—Sea-water holds in solution a large amount of salts, varying somewhat in different localities, and slightly even in the same place at different times. The Mediterranean is richest, with about $2\frac{3}{4}$ to $3\frac{1}{2}$ per cent.; whilst the water at the coasts of the British Channel and German Ocean varies from $2\frac{1}{4}$ to $3\frac{1}{4}$ per cent. The water of the Baltic, owing to the large number of streams which enter it, is much less salt, containing only about $\frac{1}{2}$ per cent. Five-sixths of all the salts are chlorides of sodium and magnesium, whilst the remainder consist of the sulphates and carbonates of lime, magnesia, and potash.

**Sea-air.**—The sea-air, and the air at the sea-shore, are considerably influenced by the constant evaporation taking place from the sea, and also by the temperature of the sea. Owing to these circumstances, the sea-air contains in general more moisture, relative as well as absolute; and is more equable in temperature, the summer being less hot, and the winter less cold at the seaside than at inland places in the same latitude; the day also may be regarded as less warm in summer, the night as less cool in winter. A very important fact is the comparative purity of the sea-air from organic admixture and inorganic dust, while the occasional presence of a greater or smaller amount of saline particles cannot be regarded as a disadvantage. The amount of ozone is greater; that of carbonic acid smaller. The variations of the barometer are greater, but more regular in their occurrence, and this possibly exercises a beneficial influence on the functions of life. The greater density of the atmosphere, which means a comparatively large amount of oxygen in a given volume of air, is often considered as one of the principal causes of the stimulating effect of sea-air; but Frankland's and Tyndall's experiments on combustion render the usual reasoning on this point, with regard to combustion and tissue-change, rather doubtful. Nor is the fact to be overlooked that the air at the sea-shore is mostly in greater agitation than the inland air; and by this circumstance is probably to be explained the experience of Benecke ('Sea-air and Mountain-air,' *Deutsch. Arch. f. Klin. Med.*, vol. xiii. p. 80, 1874), that the same body of hot water loses its heat more rapidly at the sea-shore than at various elevations in Switzerland, varying from 3,000 to 6,000 feet above sea-level—an experience from which we may infer that living bodies likewise give off more heat at the sea-shore than in elevated inland regions. The physiological effects of sea-air may be designated, with Braun (*Curative Effects of Baths and Waters*, English edition, 1875, p. 253), as 'powerful stimulation of the change of substance, both retrogressive and formative, expressed in a striking increase of urea, and decrease of uric acid and phosphoric acid in the urine, in the greatly increased requirements of food, and in the rapid and considerable increase of the weight of the body.' A certain power of responding to the increased stimulus of the sea-air is, however, required of the constitution; for the increased tissue-change necessitates an increase in the ingestion of food, and in the processes of excretion of the products of retrogressive tissue-change. If the digestive and

assimilative organs be unable to satisfy the former demand, various digestive disturbances arise, the appetite fails, and emaciation is often the consequence. In many of these conditions greater benefit is derived from mountain health-resorts, where the demands made on the constitution are less great, and where less food is required. If the excretory functions be imperfect, as is the case in so-called 'bilious' individuals, and in some undefined gouty tendencies, headaches, giddiness, constipation, or other symptoms usually called 'biliousness,' make their appearance, and sometimes render the removal from the sea-shore necessary, though the use of aperient remedies, reduction in the amount of food, and especially of stimulants, and active exercise at some distance from the sea, often suffice to correct this defective elimination and its consequences. In many cases of this kind, however, courses of mineral waters, especially the alkaline, saline, or common salt springs, ought to precede the stay at the seaside. *See* MINERAL WATERS.

**Sea-baths.**—The sea-bath may be regarded as a powerfully stimulating cold-water bath, modified in its action by the saline ingredients; by the admixture of mechanical particles, organic as well as inorganic; by the varying degree of motion through the waves; and by the alternation in the exposure of a part of the body to the waves and to the air. We have already discussed the temperature of the sea-water, and the saline ingredients; but the temperature of the surrounding air, and the degree of motion in the air, also exercise a modifying influence on the effects of the sea-bath. The motion of the water varies constantly, according to the size and force of the waves, and the effect of the bath to a great degree depends on this point. When the waves are in any degree powerful, the upper part of the body is exposed to the coming, the lower to the receding wave, and the cutaneous nerves are not only influenced by the cold, but also by the force of the water, and by the sand and other substances mixed with it. In a quiet sea these influences are considerably lessened. The alternation of exposure to the water and the air, likewise occasioned by the waves, is peculiar to the sea-bath, and is another source of constantly changing impressions on the cutaneous nerves.

BATHING-SEASON, AND RULES FOR USING IT.—The season for sea-bathing varies according to the climate of the locality. Thus it extends on the Mediterranean shores from May to October and even November; on the shores of the English Channel and German Ocean from June to September and the beginning of October. The time of the day for sea-bathing must depend on the individual, on the weather, and on the tide. Delicate persons ought not to bathe with a perfectly empty stomach; but also never after a full meal. The duration of each bath is to be regulated according to the constitution of the bather, the force of the waves, and the temperature of the water. Weakly persons ought not to remain in the water over half a minute to five minutes, but immersion for one and two minutes is in many such cases all that is useful and permissible, while stronger individuals may remain from five to ten minutes. The bather, we may say in general terms, ought to leave the water as soon as the reaction manifests itself.

In many cases, the warm sea-water bath may be recommended with advantage, when the cold sea-bath is forbidden. Indeed, courses of bathing in warm sea-water are not sufficiently used in a systematic way, though the medical practitioner possesses in them a gentle, manageable, and efficacious means of treatment during winter as well as during summer. They are in their action analogous to warm common salt-baths (*see* BATHS; and MINERAL WATERS). Unfortunately the arrangements are still very defective at many localities. Some physicians at seaside places are beginning to make more extensive use of them, and with excellent results. The tepid swimming-bath of sea-water we may regard as intermediate between the warm-bath and the bath in the open sea, and likewise as very useful in appropriate cases. With due care it can be employed also in winter. It offers the advantage of the combination of one of the most perfect modes of muscular exercise, with exposure of the skin to the influences of the sea-water bath.

The physiological effects of the sea-baths are similar to those of the sea-air. Abstraction of heat and stimulation of the cutaneous nerves lead to increased tissue-change, retrogressive as well as productive. Increased appetite and increased weight of body are usually observed in those who are benefited by sea-baths; while loss of appetite, headache, digestive disturbances, and loss of weight are often observed in those who are unable to bear the shock, or the increased demand on the body, or who remain too long in the bath, or take it too frequently.

CASES NOT SUITED FOR SEA-BATHING.—Persons affected with diseases of the heart, or of the blood-vessels and lungs, with organic diseases of the nervous system, with enlargement of the liver, or with other organic diseases of the abdominal viscera, ought to avoid bathing in the open sea, which may produce most injurious effects, such as violent palpitation and dyspnœa extending over many months, sleeplessness, total loss of appetite, and great emaciation. Old persons, and persons with feeble circulation, whether from age or otherwise, ought to avoid bathing in the open sea, excepting on warm days, and with a very quiet sea.

CASES TO BE BENEFITED BY SEA-BATHING.—Sea-bathing is useful in many conditions connected with weakness or atony of the skin, such as tendency to profuse perspiration, or to taking cold at every change of temperature, or exposure to wind or draught.

In scrofulous complaints, long-continued residence at the seaside promises more than other climatic agents; but, as we have to deal with constitutional defects, and as our aim must be to alter the constitution, two, three, or even more years are often required. In many cases, judicious courses of sea-bathing, the use of warm sea-water baths, and sponging with sea-water, assist the climatic element of seaside residence. Education at schools situated at the seaside offers, in scrofulous children, the greatest advantages.

In muscular rheumatism, the moderate use of the sea-bath combined with sea-air is useful. In more recent rheumatic joint-affections the sea-bath is mostly injurious, whilst the more gentle action of the sea-air, combined with the use of warm sea-water in local and general baths, is frequently beneficial. Persons affected with so-called nervous rheumatism—a term which is applied sometimes to hysterical cases, sometimes to spinal irritation, and also to rheumatism combined with nervous weakness—often derive benefit from the gentle use of the sea-bath, and still more from the sea-air.

In some functional diseases of the nervous system, the sea-bath forms an excellent remedy, if it be adapted to the individual case; for instance, in hysterical paralysis and other forms of hysteria, in the milder forms of diphtheritic paralysis, and in nervous dyspepsia. It must, however, be borne in mind that many persons, with a tendency to neuralgia, nervous asthma, hysterical convulsions, and other forms of hysteria, are unable to stand prolonged residence at the sea, especially at the Riviera. In such cases, mountain climates are generally more advantageous, during summer and autumn. In many forms of anæmia, when it does not depend on organic disease of the heart and blood-vessels or other viscera, but on direct loss of blood or its constituents, on confinement, grief, and imperfect food, on slow and imperfect development, sea-air exercises a good effect. Hence the benefit obtained in many cases of amenorrhœa, chlorosis, and allied complaints. Often, however, the demands made by the sea-air on the constitution are too great, and the invalids lose weight; whereas they gain on mountains of moderate elevation.

In chronic pneumonia, in the remains of pleuritic effusion, and in phthisis, the sea-air, by its purity and its more equable temperature, is useful; but as wind is in most cases to be avoided, sheltered localities are essential. Sea-bathing is in this class of cases hazardous. The beneficial effects in whooping-cough, when the first stage is over, are well known. Regarding asthma, nothing can be said with certainty; some cases of nervous asthma are benefited at the seaside, while others are aggravated; on the whole the writer's experience is more in favour of elevated regions than of the seaside. Whenever the effect is not yet known, the recommendation of seaside residence or mountain-air must be regarded as a trial; only in complications with heart-disease, the injurious effect may be regarded as certain. The advantage to be obtained in tendency to catarrh we have already mentioned.

In addition to the conditions named, there are many which cannot be designated by the name of any disease; but which are only states of weakness, manifesting themselves in various ways, as inability to sustain mental or bodily efforts, tendency to abortions, to leucorrhœa without any disease, &c. In such states of weakness the stimulating effect of the sea-air, combined with the grand aspect of the sea, are found eminently useful.

Seaside Watering-places.—England is remarkably well provided with seaside places, and the different localities offer considerable variety with regard to climate. The east coast, which may be designated as drier and more bracing, is especially to be recommended from the middle of June to the middle of October. The principal places on the east coast are, beginning with the north, Tynemouth, Redcar, Saltburn-by-the-Sea, Whitby, Scarborough, Filey, Bridlington, Cromer, Yarmouth, Lowestoft, Aldborough, Dovercourt, Walton-on-the-Naze, Southend, Margate, Broadstairs, Ramsgate, Deal, and Dover. On the south-eastern and southern coast, which may be regarded as intermediate between the eastern and the south-western coast, we have Folkestone, Sandgate, Hastings with St. Leonards-on-Sea, Eastbourne, Seaford, Brighton, Worthing, Littlehampton, Bognor, the Isle of Wight, Bournemouth, and the Channel Islands. These places differ considerably with respect to the soil on which they lie; the position—close to the sea or on a cliff; the aspect; and the configuration of the locality itself and the surrounding country. Even different parts of the same place offer different advantages. Thus the lower part of Folkestone, near the lower Sandgate road, is sheltered from the north by the cliff, while the houses on the cliff itself are more or less freely exposed to the winds from all quarters, and therefore preferable during the summer months. Hastings with St. Leonards is remarkably sheltered from the north, north-west, and to some degree from the north-east winds, and is through this, and through the influence of the sea, some degrees warmer during the late autumn and the early winter months—we may say till February—than closely adjacent but less sheltered places. In the Isle of Wight, the Undercliff, with Ventnor and Bonchurch, is sheltered by the hills from north and north-east winds, like Hastings, and more so; and has during winter a more equable and a higher temperature than other parts of the island. The Undercliff is therefore more adapted for climatic treatment during the colder part of the year; while Sandown, Shanklin, Cowes, Ryde, Alum Bay, and Freshwater are more suited for sea-bathing and climatic purposes during the warmer months. Bournemouth is sheltered as well by the configuration of the hills as by the pine-woods, which serve as a protection from violent winds. On the south-western coast, which may be regarded as somewhat moister and more sedative, Swanage, Weymouth, Sidmouth, Budleigh Salterton, Dawlish, Torquay, Teignmouth, and Penzance are the principal sea-bathing places, amongst which Torquay may be regarded as the most important winter health-resort. On the North Devon coast we may name Lynmouth, Ilfracombe, and Minehead; on the Bristol Channel, Weston-super-Mare, Portishead, and Clevedon; on the Welsh coast, Tenby, Aberystwith, Penmaenmawr, Llandudno, Rhyl; and in Lancashire, Westmoreland, and Cumberland, Grange, sheltered by configuration, Southport and Blackpool, Fleetwood, St. Bees, and Silloth.

Scotland likewise offers abundant localities for sea-bathing, the most frequented of which are Nairn on the east coast, Rothsay in Bute, Ardrossan near the firth of Clyde, and the Isle of Arran on the west.

Ireland is even richer, with Bray and Kingstown, near Dublin; Duncannon and Tramore on the south coast; Rostrevor and Portrush further north; Bundoran in the north-west; Kilkee in the south-west; and Queenstown, a sheltered and warm, but moist, climatic health-resort in the south, where are also Youghal and Ballycotton.

On the north coast of France, Calais, Boulogne, St. Valery, Tréport, Dieppe, Etretat, Fécamp, Havre, Trouville, Deauville, Villers-sur-Mer, and Dinard, are the most favourite resorts; on the south-west, Arcachon and Biarritz; and on the south, Marseilles, Cannes, and Nice.

The west and south-west coasts of Italy possess many good localities for sea-bathing for those requiring, or at all events bearing heat, such as Bordighera, Alassio, San Remo, Castellamare, Sorrento, and the islands of Capri and Ischia.

On the coast of Belgium, Holland, and Germany the most important localities are Blankenberghe, Ostend, Scheveningen, Borkum, Norderney, Baltrum, Langeroog, Spikeroog, Wangeroog, Dangast, Cuxhaven, Wyk, and Westerland.

The coasts of Norway, Sweden, and Denmark offer likewise good opportunities for sea-bathing, combined with bracing sea-air, from July to September.

**Sea-voyages.**—Sea-voyages have from remote antiquity formed a mode of treatment in chronic diseases, especially of the respiratory organs, and have more lately been much recommended in the treatment of consumption and scrofulous affections; but the different influences to which the invalid is exposed on long sea-voyages are but little appreciated in their details by the majority of the public, or by medical men.

The essential advantages which are generally ascribed to sea-voyages are the enjoyment of perfectly pure sea-air, abundance of light, and free exposure to the sea-breezes; absence, or at all events great limitation, of bodily exertion; and the probability of psychical repose. The uninitiated frequently regard these advantages as more or less fixed and, so to say, measurable qualities, and speak of sea-voyages in the same way as of sea-bathing, cold-water treatment, mineral-water cures, or mountain climates. The advantages of sea-voyages are, however, by no means fixed qualities, and they are often mixed up with unfavourable influences, such as bad weather, sea-sickness, improper food, &c. In every-day life it is an acknowledged fact, and not less so in all climatic cures, that the house in which the invalid lives exercises a most powerful influence on his chance of regaining and maintaining his health; and that the house alone often mars the effect of the best adapted climatic change. In the same way the floating house, the ship, with its arrangements, forms one of the most important elements in the compound agent 'sea-voyage.' The arrangements of ships, however, are notoriously often very imperfect, and the narrow cabin never stands comparison with a good bedroom, the only counterbalance to this drawback often being that the invalid is forced to be the whole day long on deck, that is, in the open air, in order to escape from the confined state of the cabin. By this circumstance alone, however, the majority of the more serious cases ought to be excluded from sea-voyages in ordinary ships, as they cannot be easily moved from the cabins to the deck, and *vice versâ*. The hygienic conditions of the ship, the space allotted to each passenger, the ventilation of the rooms, the arrangement of the decks, must in every case be a matter of careful enquiry; but it would require too much space to enter into the details in this place. There are iron and wooden ships, steamers and sailing vessels. The iron ships have the advantage of being easily kept clean and free from smells, but they are apt to become very hot under the influence of the tropical sun. The sailing vessels can be kept more free from smoke and dust; but they are dependent on wind, and if they meet in the tropics with perfect calms (doldrums), the passengers may have to endure intolerable heat for several days and possibly weeks. The combination, therefore, of sailing power for ordinary conditions, with steam to be used only in case of need, would appear to possess the preference for ships to be used for therapeutic purposes (invalid ships).

A second point of paramount importance for every delicate person is the food, and in this respect again the ship-life on long voyages is less advantageous than the life in well-supplied health-resorts or at home. Although the food on first-rate ships is now much improved, compared with former times, yet it is impossible to offer the same variety, or the same delicate cooking, as in first-class hotels or private establishments. A certain amount of monotony in food is scarcely to be avoided, and invalids with a delicate appetite ought therefore not to attempt long sea-voyages, excepting under very favourable circumstances, as, for instance, on large private yachts provided with good cooks.

*Sea-sickness*, or rather the degree of liability to sea-sickness, depends on peculiarities of constitution, which are only to be recognised by exposure to the influences of the open sea in different states of agitation. *See* SEA-SICKNESS.

We have given, under the head of sea-air, the prominent qualities of sea-climates; but the most cursory consideration of the climatic conditions to be encountered in a long sea-voyage, shows that there must be great differences between the physiological and therapeutical influences of sea-climates in latitude 50° and in latitudes 15° and 5°. The air in the tropical regions has a much higher temperature and a larger amount of absolute moisture; the atmospheric movement is, as a rule, though by no means always, slighter; the barometric pressure is somewhat less in the tropics than in the temperate zones; and the daily and annual variations of atmospheric pressure are greater in the former than in the latter. There is also a difference between the same degrees of latitude on the north and south of the equator, the temperature in the southern hemisphere, for instance, being somewhat lower than in the northern, but these differences are comparatively small. The effects of the climatic conditions of sea-life in different latitudes on the constitution are very complicated. We will here only point to a few facts, namely, that in some delicate constitutions the functions of life are performed more easily under the influence of greater heat; that many delicate persons can eat and digest better, are able to take more exercise, sleep better, and

their mental functions are more active under the same circumstances; but that in the majority of average persons continued great heat produces lassitude, a tendency to diarrhœa and other digestive derangements, and imperfect sleep. Further, that in most individuals the bodily temperature rises above the natural heat (in general about $\frac{1}{2}°$ Fahr., and in some persons as much as 2° and 3° Fahr.); and that pulmonary hæmorrhage occurs more frequently under high than under ordinary degrees of heat. Morbid states accompanied with pyrexia and with a tendency to pulmonary hæmorrhage ought therefore not to be exposed to tropical heat.

The climatic conditions to be met with in different voyages through the same regions vary at different seasons, but they vary still more in voyages through different seas, especially according to the longitude and latitude. Our knowledge of different sea-climates, that is, of the different climatic conditions in different parts of the ocean, is as yet not perfect. Dr. Faber, in a communication 'On the Influence of Sea-voyages on the Human Body,' *Practitioner*, March 1876), shows that the equability of sea-climates is by no means so complete as is generally assumed; and that great changes in temperature and atmospheric movements occur not rarely on successive days, and even on the same day.

Therapeutical Uses.—The opinions of different writers on the therapeutic value of sea-voyages in the treatment of disease vary considerably. In the last century Gilchrist revived the practice of sea-voyages, and strongly recommended them in cases of phthisis. In more recent times Jules Rochard, the well-known French climatologist, has collected a large body of evidence from the French Navy to dispel the faith in sea-voyages; but we must bear in mind that the hygienic condition in which the sailors used to live were not perfect, and are no doubt inferior to those of well-arranged private ships of the present day. Dr. Walshe, on the other hand, is in favour of well-planned voyages. The majority of physicians entirely, or almost entirely, confine themselves to diseases of the respiratory organs in recommending sea-voyages; but their therapeutic field is no doubt much larger, and the result is probably more generally favourable in some other complaints.

1. *Phthisis.*—The writer has had the opportunity of witnessing the effects of sea-voyages of two to seven months' duration, in twenty-one cases of phthisis in the first or the beginning of the second stage. Of these twenty-one cases ten benefited considerably, six remained stationary, five became worse. The voyages were all either to the Cape of Good Hope and back, or to Australia and New Zealand and back, between the months of September and May. Of the five bad results three occurred in patients who went to Australia and India and back, with scarcely any rest on land; they seemed to have gained in the first part of the journey, but more than lost the gain in the latter part, apparently from dislike of food, from the monotony of the life, and from exhaustion. In seven cases of phthisis in the second stage the result of sea-voyages was favourable only in 2, indifferent in 2, bad in 3 cases. In 4 cases in the third stage the result was bad in 2, indifferent in the two others, which latter were stationary or 'quiescent' cases. The writer has also notes of 4 cases of phthisis in the first and the beginning of the second stage, where long summer voyages (namely, from three to five months) with whalers to the northern seas, were tried, the result being favourable in 3 cases, unfavourable in 1, apparently through inability to bear the want of variety in food.

2. *Laryngeal and bronchial catarrh and asthma.* In simple chronic catarrh of the larynx sea-voyages, or cruising in yachts from this country to the Mediterranean, to the Azores and Madeira, had very good results in 8 cases out of 9. Satisfactory was also the effect of a similar plan in 7 cases of chronic bronchial catarrh. In a tendency to bronchitis from pulmonary emphysema the benefit was likewise evident in 7 cases out of 8, but here the effect was, from the nature of the circumstances, less permanent. Of 6 cases of asthma, 2 cases of a bronchitic kind were benefited; 2 of a nervous character aggravated; and 2 were neither better nor worse. Eight cases of hay-asthma were, while on the high seas, quite free, but those who returned while the complaint was still in season, were immediately attacked.

3. *Scrofula.*—In 9 cases of scrofulous affections (caries of bones, affections of joints, glandular swellings and ulcerations) one or several long sea-voyages were tried; in 6 of them the effect was quite satisfactory, in 3 less decided.

4. *Vesical disease.*—In 3 cases of irritable bladder sea-voyages on yachts in warm climates have likewise proved useful.

5. *Cardiac disease.*—Decidedly injurious was the effect of sea-voyages in 5 cases of dilatation of the heart, combined with chronic bronchitis. In 2 cases of enlargement of the liver, connected with weakness of the heart, the result was likewise unsatisfactory.

6. *Skin-disease.*—Chronic eczema was, in 5 cases out of 6, aggravated by sea-voyages.

7. *Nervous disorders.*—In 4 out of 6 cases of mental irritability, long sea-voyages, especially in yachts, had favourable results; in the 5th the mental condition was aggravated; in the 6th great improvement of the mental state was obtained, but this was accompanied by considerable exhaustion, from inability to take a sufficient amount of food. Of 3 cases of melancholia 2 were apparently cured, the third remained uninfluenced. In 4 cases of locomotor ataxy, in the earlier stage, cruising in comfortable yachts in the Mediterranean, with occasional landing, during the autumn, winter, and spring months, has been very beneficial; in two of these the disease has apparently been arrested, by persevering with this course during five and six years.

8. *Dipsomania.*—Finally, the writer has tried long sea-voyages in yachts in five cases of dipsomania, stimulants having been entirely excluded from the dietary. In one of these cases the result appears to be permanently good; in the four others it was good for the time with regard to the state of the body as well as of the mind, but there were relapses, which in two of the cases have led to several repetitions of the trial, each time apparently with more lasting, but as yet

not permanent, result. Well-arranged sea-voyages deserve therefore, at all events, a place in the management of this most terrible affection.

Conclusions.—From a comparison of these experiences with those of other observers, the writer is inclined to infer that, under favourable circumstances, sea-voyages of not too long duration may be rendered beneficial in the early stages of phthisis. The voyage to Australia and New Zealand and back, after a stay of a few months in these climates—Hobart's Town, in Tasmania, for instance—specially recommends itself. The invalids referred to left in the second half of September, or in October or November, and returned in May or June. In this way the more unfavourable seasons of England are avoided, and instead of the short and sunless days, long and bright ones are obtained. To go to Australia and to return immediately has proved exhausting in several instances. Another good plan is to go to the Cape of Good Hope, and ascend in easy stages, by diligence and bullock-carts, to the higher regions (Bloemfontain, for instance), and to return after a stay of three or four months or more. This plan, however, is rather expensive; and it requires a considerable amount of bodily strength, and the inclination to stand a certain amount of roughing with regard to accommodation and food.

The voyage to the northern seas requires a peculiar mental disposition, and would, under the present conditions, be resorted to only under exceptional circumstances; but it has been very beneficial in the three cases of early phthisis mentioned—all of them possessing a satisfactory fund of strength, combined with love of sea-life and a good digestion.

The combination of yachting in the Mediterranean, and residence at one or several of the health-resorts of those regions, or with a visit to Upper Egypt, has repeatedly proved successful in cases under the observation of the writer, not only in pulmonary invalids, but also in cases of mental irritability, exhaustion, chronic rheumatism, and gout. This plan, however, is somewhat expensive.

In hay-asthma sea-voyages during the season of the complaint are to be recommended; but in other forms of asthma the result is uncertain, and the advice should not be given without consideration of all the circumstances.

In some forms of mental irritability, and in the earlier stages of locomotor ataxy, sea-voyages, and especially yachting, in the subtropical regions, offer many advantages, particularly during the colder and damper seasons of our climate, as it allows of the combination of the enjoyment of sun, light, and pure air, with rest of body and mental repose. In slighter forms of mental irritability or overwork shorter voyages are often sufficient, and even preferable; and the voyages to Madeira, to the West Indies, or to Brazil and the River Plate, may thus be recommended during the colder season.

Dipsomania and other morbid passions may be treated with great advantage by sea-voyages and yachting, provided that stimulants and the other injurious influences which the weak person is unable to resist, can thus be entirely removed.



The time may come when we shall have *therapeutic ships*, specially arranged for different classes of invalids. It would, for instance, not be wise to mix those suffering from dipsomania with sick persons to whom a moderate amount of stimulants is useful.

Circumstances counter-indicating Sea-voyages. The circumstances which render it necessary to avoid sea-voyages are:—

1. Unconquerable sea-sickness.
2. Great temporary or permanent weakness and exhaustion.
3. Permanent delicacy of appetite, with inability to become accustomed to a certain monotony of food, or to a certain coarseness in the preparation of food.
4. Inability to bear the glare of the sea, as it occurs in tendency to glaucoma.
5. Persistent sleeplessness while at sea.
6. Dilatation and weakness of the fibres of the heart, with or without valvular disease.
7. Enlargement of the liver, especially when caused by dilatation of the right ventricle.
8. Advanced stages of consumption, unless the affection be quite stationary.
9. Morbid conditions with a tendency to pyrexia.
10. A tendency to hæmorrhage.

It is the influence of great heat that ought to be avoided by the two classes of cases last mentioned. A voyage through tropical seas, especially in sailing ships, might prove dangerous in such subjects, from the possibility of being becalmed.

11. A tendency to epilepsy or maniacal fits. This ought specially to contraindicate sea-voyages to tropical climates.

For further information regarding sea-voyages, reference may be made to *The Ocean as a Health-resort*, 1880, by Mr. William S. Wilson; and further to a treatise on sea-voyages, by Dr. Faber of Stuttgart, which is issued as a part of Von Ziemssen's *Handbuch der Allgemeinen Therapie*.

Hermann Weber.

**SEA-SICKNESS.**—Synon.: Fr. *Mal de mer*; Ger. *Seekrankheit*.

Definition.—A peculiar functional disturbance of the nervous system, produced by shock, resulting from the motion of a ship. The most prominent symptoms are a state of general depression, giddiness, vomiting, and derangement of the bowels and of the urinary secretion.

Pathology.—The immediate cause of sea-sickness is referable to the shock, or series of shocks, to the nervous system, produced by the motion of a ship. A precisely similar condition may frequently be induced by any forcible motion for which the individual is unprepared, or to which he is unaccustomed, as the motion of a swing. The nervous system is taken unawares, and is unable to adapt the emissions of nerve-force to the unexpected demands made on it. The momentary displacement of the viscera, especially the stomach, the unusual impression on the vision, and the feeling of insecurity, further contribute to the general shock.

The action of the heart and of the arteries is deranged through reflex influence, causing giddiness from anæmia of the brain, and diminished

peripheral circulation. The stomach is also affected through reflex action, rendering it intolerant of the presence of any substance, and causing the gastric juice to be actively secreted. The acid secretion acts as a direct irritant to the stomach, and prolongs the sickness. At length *habit* enables the nervous system to adapt itself to the new condition of motion, and to overcome the disturbing influence; shock consequently ceases to be produced; the reflex derangements of the circulation and viscera, giddiness, nausea, and other disorders, are no longer called forth; and convalescence ensues. It is not within the scope of this article to notice the many theories which have been adduced to account for sea-sickness, but most late writers attribute it to reflex nervous disturbance. Dr. Chapman's theory is, that there is an undue amount of blood in the nervous centres along the back, producing an abnormally large number of exciting impulses, which cause a copious secretion of mucus in the stomach and bowels, vomiting, and coldness of the extremities from contraction of the minute arteries. Some persons are totally insusceptible to the shock producing sea-sickness.

Constipation is probably the result of the want of the gastro-biliary juices and mucus in the bowels, these being vomited; and the diminution of urine may be accounted for, in part at least, by the increased secretion of mucus and saliva.

Anatomical Characters.—The writer has only had the opportunity of taking notes of one autopsy in a case of ordinary sea-sickness, in which the patient died suddenly. The appearances were those of death by simple syncope, there being no organic disease present. The brain, however, was not examined.

Symptoms.—Sea-sickness may be divided into the stages of (1) Depression, (2) Exhaustion, (3) Reaction, and (4) Convalescence.

The early symptoms are sudden giddiness, slight at first, but increasing with the motion of the vessel; and a sense of weight and uneasiness at the epigastrium, speedily followed by nausea and vomiting. At first any food that may have been in the stomach is rejected; and afterwards acid, greenish-yellow, gastro-biliary secretions, often in large quantity, with mucus. Diarrhœa is sometimes present, but constipation is more usually the rule throughout. The flow of saliva is increased, while the urinary secretion is lessened. Appetite is lost, even the sight or smell of food being loathsome. The secretion of milk is frequently arrested in nursing women; in others the menstrual flow is augmented. Sea-sick patients are always worse in the morning. Women suffer more severely than men as a rule, while old people and young children are but slightly affected, or escape altogether. In the majority of cases a favourable *reaction* takes place without further symptoms, the vomiting and nausea cease spontaneously, a ravenous appetite succeeds, and the patient feels well. In other instances great *exhaustion* supervenes rapidly or gradually The patient feels miserably helpless. He suffers from coldness of the extremities, thirst, headache, and spasmodic pain in the stomach, and complains of numbness of the surface of the body. There is frequently a great tendency to heavy sleepiness; and vomiting of gastro-biliary fluids, sometimes mixed with striæ of blood, takes place whenever they collect in the stomach. A semi-comatose condition, from which the patient is with some difficulty roused, is sometimes met with in very severe cases, and requires assiduous treatment.

In these prolonged cases *reaction* may assume a febrile character, with a rapid pulse, flushed face, hot skin, and urine containing lithates; and convalescence is slow.

An occasional but rare form of sea-sickness is swooning, but without vomiting or any other symptom. The patient lies motionless and almost deathlike for a variable period. This state is not without danger. Another form is frontal headache, neuralgic or anæmic.

Complications and Sequelæ.—Fainting and hysterical attacks are the most common complications of sea-sickness in women. Pregnant women occasionally abort. A weak and irritable condition of the stomach, resembling subacute gastritis, or a state of general debility, may remain for a long time.

Duration.—The ordinary duration of sea-sickness in long voyages is from three to five days, but it may last for weeks.

Prognosis.—This is almost invariably favourable, yet death, although extremely rare, may occur from syncope or from exhaustion.

Treatment.—It may be premised that there is no known means of preventing sea-sickness in those susceptible of it. The majority of cases get well spontaneously, but there are many which will require systematic treatment, especially in long voyages. Measures should be taken to counteract the nervous shock, and to sustain the system during its continuance.

Diet before embarking should be light. Fresh air is a powerful element in the treatment, to obtain which the voyager should remain on deck whenever the weather permits, or in a deck-room. The temperature of the body should be maintained by wrapping up in shawls, and hot bottles applied to the feet if necessary. The face may be bathed occasionally with eau de Cologne, and the vapour of ammonia inhaled through the nose. In the early stages alkalies are indicated, to counteract the irritant effects of the acid gastro-biliary secretions, together with diffusible stimulants frequently administered. A draught may be given, consisting of bicarbonate of soda, grains 10–20, ammoniated tincture of valerian, ♏xv, chloroform, ♏iii–v, dissolved in half a drachm of rectified spirit, mucilage of acacia, ʒjss, and camphor water to ℥j. Such a draught may be given every two hours, or, omitting the mucilage, it may be given in effervescence with citric acid. Chloroform is valuable as a sedative to the stomach, as well as being a general stimulant. Other useful drugs are Hoffman's anodyne, hydrocyanic acid, and, in prolonged cases, bismuth. Iced champagne is often valuable. Ice sucked slowly allays thirst, and relieves vomiting. A full dose of opium sometimes acts like a charm, through the rest which it procures, or morphia may be injected subcutaneously. Hydrate of chloral is also a valuable narcotic. More recently nitrite of amyl and nitro-glycerine have been successfully employed in some instances.

External sedative applications over the stomach

do good, such as a liniment composed of equal parts of belladonna, chloroform, and camphor liniments; and a binder rolled firmly round the body is useful. When the patient is in his berth he should lie on his back, with his head low, as immovable as possible. Notwithstanding the vomiting, food should be pressed on the patient; and, lest exhaustion occur, light semi-fluid food is the best, such as arrowroot, given frequently in small quantities. Afterwards toasted bread, with beef-tea or chicken broth, and when these are borne, boiled fowl, pickled meats, or corned meat with pickles, may be tried. Acids at this stage aid digestion, which has become weakened through the vomiting of so much gastric juice and bile. Beer and alcoholic drinks should be avoided in the earlier stages; but at a later period, claret, champagne, or brandy, or stout, may be allowed with benefit. Diarrhœa and other symptoms should be treated on general principles. For short voyages the best that can be done is to remain on deck when possible, avoid alcoholic drinks, and follow the general directions above given. Dr. Chapman recommends the application of ice along the spine, in order to lessen the nervous currents by its sedative influence; and this treatment is occasionally successful in arresting the vomiting.

J. DE ZOUCHE.

**SEAT-WORM.**—A synonym of the small thread-worm, or *oxyuris vermicularis*. By practitioners the small and troublesome entozoa here referred to are more frequently spoken of as *ascarides*, though, as explained elsewhere, the expression is not correct. The term seat-worm is suggestive, inasmuch as the presence of these parasites is apt to give rise to irritation in the neighbourhood of the anus; but it is somewhat objectionable and misleading, since it tends to favour the view still very commonly entertained and taught by medical men, that the rectum and sigmoid flexure of the colon constitute the true habitat of this entozoon. The cæcum forms the 'head-quarters' of the seat-worm, and the knowledge of this fact has an important bearing upon the method of treatment to be pursued. *See* ASCARIDES; OXYURIS; and THREAD-WORM.

T. S. COBBOLD.

**SEBACEOUS FOLLICLES, Diseases of.**—SYNON.: Fr. *Maladies des Follicules sébacés*; Ger. *Krankheiten der Talgdrüsen.*

The sebaceous follicles of the skin are subject to disease depending both upon internal and external causes. Those follicles which are attached to hairs, and those which are isolated, show little difference in this respect.

Enlargement or *hypertrophy* of the follicles is often seen, and appears to arise chiefly from internal causes, occurring either at a particular stage of development, or from some general alteration of nutrition, such as follows a particular diet or excess of particular kinds of food. This form constitutes *acne punctata*, an affection in which the affected portion of skin appears covered with black spots; these being the openings of the enlarged sebaceous follicles, choked with plugs of sebaceous matter, the outer ends of which become blackened. The plugs or *comedones*, when examined, are found to consist of solid fatty matter (sebaceous secretion), closely packed epithelial scales, and minute rudiments of hairs. The parasite *Demodex folliculorum* is often present, but does not appear to exercise any influence on the disease. Not unfrequently an imperfectly formed hair occupies the centre of the mass. Acne punctata occurs in those parts of the body where there are numerous rudiments of hairs, and where hairs grow commonly, though not uniformly, in the male sex. Hence it is confined to the face, neck, and upper part of the back and chest.

When *inflammation* is set up in hypertrophied follicles suppuration follows, and we have *acne suppurativa.*

The condition called *lichen pilaris* is substantially the same as hypertrophic acne, being produced by over-growth of cells in the sheath of the hair and the sebaceous follicle. *See* ACNE.

J. F. PAYNE.

**SEBORRHŒA** (*sebum*, fat, and *ῥέω*, I flow). An ungrammatical synonym for steatrhœa. *See* STEARRHŒA.

**SECONDARY** (*secundus*, the second).—In contra-distinction to *primary*, the word secondary is used with the following significations. Ætiologically it implies that a disease is not local in its causation and origin, but is manifested as a *secondary* lesion—either as the result of some general or constitutional condition, or of an affection which has previously involved some other structure or organ, it may be in a remote part of the body. It also signifies the later manifestations of a disease, as distinguished from those which occur at an early period, as in the case of *secondary syphilis* or *secondary cancer.* The term is, moreover, applied to symptoms, when they are more or less remote from the seat of mischief, or are only indirectly set up by the disease with which they are associated.

FREDERICK T. ROBERTS.

**SECRETIONS AND EXCRETIONS, Disorders of.**—Although the derangements affecting the chief secretions and excretions of the human body are considered in detail in other parts of this work, it may serve a useful purpose to deal with them from a general standpoint, as there are several facts which apply to them collectively. Those that have principally to be borne in mind are the secretions poured into the alimentary canal—namely, the saliva, gastric juice, bile, pancreatic juice, and intestinal secretions; the milk; the urine; and the sweat. Of secondary importance, from a clinical point of view, are the various mucous secretions, the tears, and the semen; the serous secretions have also to be remembered. It is assumed that the physiological distinction between a secretion and an excretion is understood.

VARIETIES OF DISORDER.—1. Secretions and excretions are very liable to *changes in quantity.* A definite amount of each of these should be formed during the twenty-four hours, varying within recognised limits, and influenced by certain physiological conditions. The quantity produced, however, often deviates from the healthy standard, in the direction either of (*a*)

*excess*, or (*b*) *deficiency*. In the former case the amount of the secretion formed is often far above the normal, or what is needful for its purpose; in the latter case various degrees of deficiency occur, culminating in an absolute suppression of a particular secretion or excretion.

2. *Changes in quality* are also frequently noticed, and these may be associated with changes in quantity, or they may exist alone. The qualitative changes include the absence or deficiency of one or more of the normal chemical ingredients of the fluid; excess of either of these ingredients; absence, deficiency, or imperfection of formed organic elements, as in the case of the semen; or the presence of adventitious and abnormal ingredients. It may also be mentioned here that the quality of secretions is often modified by admixture with excess of mucus or with morbid products.

3. Another disorder affecting certain secretions and excretions is *interference with their escape* by the normal channels, so that they are retained. This applies particularly to those which have one or more special ducts for their exit, liable to be obstructed in various ways. The escape of the bile, pancreatic juice, urine, parotid secretion, milk, and other fluids may be thus prevented.

4. Allied to the deviation just noticed is that in which a secretion *flows in some abnormal direction*. As illustrations may be mentioned salivary fistula, in which the parotid secretion escapes through an opening on the outside of the cheek; external biliary fistula, or the opening of the gall-bladder in various other directions; vesico-vaginal or vesico-rectal fistula, where the urine passes from the bladder into the vagina and rectum respectively; and closure of the lachrymal duct, so that the tears flow over the cheeks. In this connection allusion must also be made to those cases in which a reservoir of some secretion ruptures, and thus its contents escape. For instance, the gall-bladder may give way, or the urinary bladder, the bile or urine consequently escaping into the peritoneum.

Ætiology.—The causes which produce one or other of the disorders of secretion just indicated are as follows:—1. Alterations in quantity and quality are often immediately induced by nervous disturbance. The influence of the nervous system upon the act of secretion is well known, and it may be centric in origin, as in the case of strong emotion; direct, when the nerve influencing a particular secretion is irritated, compressed, or otherwise disturbed; or reflex, due to some remote irritation affecting such a nerve. The effect of neuralgia upon the secretion of the tears, saliva, and perspiration, is often very striking. 2. Similar disorders frequently depend upon derangements affecting the local circulation in the secreting gland. This is well exemplified in the case of the urine, which is abundant and watery as the result of active congestion of the kidney; deficient, concentrated, and otherwise abnormal when these organs are the seat of venous congestion. The bile is also considerably modified in quantity and quality by portal congestion. 3. General conditions of the system materially affect secretions, from various causes, such as pyrexia, plethora or anæmia, shock or collapse, and the typhoid condition. Moreover, they may be disordered in connection with diseases which produce marked effects upon the general system, such as phthisis. 4. Functional derangements of the glandular structures which form different secretions are very common, and may be due to many causes. Amongst others may be mentioned a want of due and proper stimulation; excessive or too frequent stimulation; injurious habits which affect certain secretions; and want of tone or imperfect nutrition of secreting tissues. Such causes frequently operate injuriously in relation to the secretions poured into the alimentary canal. The sweat is affected by neglecting cleanliness of the skin. 5. Organic diseases of the glandular structures necessarily modify secretions more or less, either temporarily from acute disease, or permanently from some chronic mischief, which may ultimately entirely check a secretion. These diseases are of different kinds, and cannot be specially indicated here, but they all tend to alter or destroy the secreting structures. 6. The secretions generally may be affected by certain abnormal elements which accumulate in the blood. Under such circumstances, however, some excretions become the special channels for the elimination of these elements, and thus are liable to be seriously deranged. Thus in diabetes, whatever its pathology may be, the accumulation of sugar in the system leads to the characteristic changes in the urine observed in this disease, while at the same time the cutaneous excretion is diminished. It may further be remarked here that if the elements which ought to be removed by a certain excretion are not thus eliminated, they may find their way by other channels, and thus modify the quality of other fluids. This is exemplified by the elimination of urea in other directions when it is not excreted by the kidneys. 7. A secretion may be properly formed, but it is in many cases subsequently modified by admixture with morbid products derived from surfaces with which it has to come in contact, such as excess of or unhealthy mucus, or pus. Also, in the case of the stomach, the habit of taking large quantities of water or other fluids may so dilute the digestive secretions, as to make them unfit to perform their functions properly. 8. With regard to the causes which impede the escape of secretions, these are either of a mechanical nature, the duct being obstructed by something lodging in it, such as a calculus or plug of mucus, or being pressed upon from the outside; or due to organic disease, narrowing or closing the channel or its orifice; or possibly occasionally to muscular spasm or to paralysis of the duct. Such conditions may be temporary or permanent. The discharge of secretions in abnormal directions is the result of organic lesions, either congenital or acquired, by which the unusual channels and communications are formed.

Effects and Symptoms.—Disorders affecting secretions and excretions are often directly accountable for a variety of symptoms, as well as for certain definite morbid conditions, and these effects are usually readily explained. 1. With reference to their quantity, secretions and excretions must be regarded as mere liquids of a particular kind, and symptoms may therefore

simply depend upon their amount. For instance, deficiency or excess of saliva and buccal mucus will cause respectively dryness of the mouth, or a more or less profuse flow of saliva; an abundance of gastric juice may account for acidity and acid eructations; the quantity of the secretions in the alimentary canal often aids in the causation of diarrhœa or constipation; and variations in the amount of the cutaneous excretion give rise either to undue sweating, or to dryness of the skin. 2. Certain actions are frequently influenced by disorders of secretion. Mere alterations in quantity may affect these actions. Thus, profuse salivation causes frequent spitting or swallowing; abundant secretion in the air-passages excites coughing and expectoration; excess of fluids in the stomach or intestine may cause vomiting or purging respectively; a free secretion of urine renders micturition more frequent. But, apart from the quantity, the quality of a secretion may further influence these actions. Of this we have a striking illustration in diabetic urine, which is in itself irritating, and excites the bladder to empty itself. The bile is another example, for undoubtedly this fluid has an irritating effect upon the intestine, and may also increase the secretions of this canal, so that in these ways excess of bile may be a cause of diarrhœa, while its deficiency is an important element in many cases of constipation, owing to the want of its stimulating action upon the intestinal wall. 3. Each secretion,.as distinguished from an excretion, has certain definite functions to fulfil, and a number of symptoms may be due to the fact that a particular secretion fails to perform its functions. This may arise from the fact that it is suppressed or deficient in quantity; abnormal in quality, and therefore inadequate for its work; or for some reason or other does not reach the place in which this work is carried on, as when a duct is obstructed, or a fistula allows the escape of a secretion, so that it is lost. Symptoms arising from this cause are mainly observed in connection with the alimentary canal, and they are of extremely common occurrence, as well as of varied character. Many of the symptoms in dyspeptic cases are to be thus explained, and a knowledge of the physiological uses of the different digestive secretions will indicate the derangements to be anticipated when one or other of them is unequal to its work. It must be remembered not only that these secretions are concerned directly in digesting the food, but that some of them also prevent fermentation and decomposition, and their imperfect action in these respects may originate important symptoms. Under this heading the lacteal secretion may be alluded to. Deficiency in its quantity, or imperfection in its quality, often renders it unfit to fulfil its function, that is, the proper nourishment of the infant who is supposed to live upon the maternal milk. 4. If certain secretions or excretions are seriously checked or altogether suppressed, or if they are retained in any part, so that they become subsequently absorbed, obvious effects on the entire system are produced, which may be of a very serious character. Thus, in the case of the bile, jaundice and its accompanying phenomena are evident; in connection with the urine we may have dropsy or uræmic symptoms. Impaired cutaneous excretion also produces effects upon the system, although these are not so marked. 5. What may be regarded as the secondary effects of disorders connected with secretions must also not be forgotten. If their escape be prevented, they are liable mechanically to produce important lesions. Thus they often lead to distension of hollow organs, such as the bladder or gall-bladder. Moreover, they may at the same time excite irritation and inflammation, especially if, as in the case of the urine, decomposition take place, with the formation of irritating products. By these combined effects, important organs may ultimately be completely disorganised, such as the kidney or liver. Retention of milk in the mammary glands is one important cause of inflammation and abscess in these organs. When certain secretions or excretions find their way into abnormal situations they may also originate more or less serious conditions. Thus if urine or bile escape into the peritoneum, acute peritonitis will be set up.

Treatment.—Without entering into any details, it will suffice to indicate in this article the principles upon which disorders of the secretions and excretions are to be treated. 1. Any obvious cause of such disorders must be rectified or got rid of at the outset, if practicable, as, for instance, injurious habits, neuralgia, and many other causes. 2. When secretions are abnormal in their formation, either as regards quantity or quality, means are often within reach for correcting these errors. This may not uncommonly be effected by acting upon the general system, by means of tonics or other suitable agents, and thus indirectly influencing secretion; but there are also special therapeutic agents employed for their immediate effects upon particular secretions or excretions, such as the gastric juice, the bile, the urine, and the sweat. With regard to quantity, remedies are used to diminish this when excessive, as well as to increase it when deficient. It may be mentioned here that measures for augmenting certain secretions, and especially excretions, are often resorted to for other therapeutic purposes, when they are not in any way abnormal. Care must be taken not to carry measures for promoting the formation of secretions too far, otherwise in the long run they are liable, by over-stimulation and in other ways, to do far more harm than good. This applies particularly to those cases where there is organic mischief affecting the glandular structures, and interfering with their formation. Secretions and excretions are often materially influenced in quantity and quality by acting upon the circulation in the organs which form them, either directly or indirectly. 3. It may be practicable to treat some disease which originates a disordered secretion, and thus to influence it. This may be illustrated by diabetes, and by diseases of particular organs, the secretions of which are affected. In this way marked effects are sometimes produced. 4. When certain secretions are wanting or very deficient, especially the gastric juice and bile, their place may be supplied by administering the important elements of these secretions, or by making them artificially. The elements of the pancreatic juice are also now frequently given in different forms. Thus the want or de-

ficiency of these fluids in the digestive process may often be entirely made up for. An important use of some of these substitutes, at present much in vogue, is that introduced by Dr. William Roberts, by which the food is artificially digested in different degrees before it is taken by the patient. 5. The symptoms which disorders of secretions give rise to often need special treatment, whether they be of a local or general character—for instance, constipation, diarrhœa, flatulence, jaundice, uræmia, and other phenomena. 6. In many cases attention has to be directed to the prevention of an accumulation of a secretion or excretion, or to its removal if it have accumulated. This may be illustrated by retention of the milk in the mammary gland; and of the urine in the bladder. The effects of any such accumulation also need to be recognised in treatment, such as dilatation of an organ, inflammation, or rupture. 7. Operative procedures may be required in some cases, either to remove an accumulation which cannot otherwise be got rid of; or to cause a secretion to pass in its proper direction, in those cases where there is an abnormal communication or fistula, or a closed passage, such as an obstructed lachrymal duct.

It must be remembered that there are many disorders of secretions and excretions which are merely temporary, and which need no treatment whatever. FREDERICK T. ROBERTS.

**SEDATIVES** (*sedo*, I ease or assuage).—SYNON.: Fr. *Sédatifs*; Ger. *Beruhigende Mittel.*

DEFINITION.— Therapeutic measures which exert a soothing action upon the system, by diminishing pain, lessening functional activity, or tranquillising disordered muscular movement.

Sedatives may be divided into the following groups:—

1. **General Sedatives.**—Constitutional sedatives, like stimulants, widely overlap other therapeutic divisions. The type of all soothing action assuredly must be a full narcotic, an anæsthetic vapour, or a subcutaneous injection of morphia, either of which renders the sufferer temporarily oblivious to any excruciating agony, such as that of biliary or renal colic. In fact, general sedatives must be looked for exclusively in the narcotic and anæsthetic class; and if the constant consumption of vital energy by disease be not compensated by sleep, we prescribe opium, chloral, or hyoscyamus.

2. **Local Sedatives.**—Under this heading we must place extreme cold, which, applied either in the form of ice, or more effectually by the ether spray, deadens the sensibility of the skin, and prevents the prick or cut of a slight operation from being felt. Next come aconite, opium, belladonna, veratria, and blisters, which soothe by a direct action on the sensory nerves, or by influencing the circulation of the parts around. These are useful in neuralgic or rheumatic pain, or in the acute suffering of superficial inflammatory conditions. Again some substances may be regarded as sedatives, in virtue of their power in allaying the excessive itching of prurigo and other chronic skin-affections. Hydrocyanic acid, carbolic acid, chloroform, borax, and chloral are among the best remedies for this purpose.

3. **Pulmonary Sedatives.**—Pulmonary sedatives are also deserving of mention, and, passing by emetics and nauseants, which undoubtedly depress the breathing power, we find that veratria, Calabar bean, prussic acid, and several other drugs directly tend to paralyse the respiratory centre, on which action the greater part of their poisonous influence seems to depend.

4. **Spinal Sedatives.**—Spinal sedatives have precisely an opposite effect to spinal stimulants, and it has been amply proved that Calabar bean, gelseminum, bromide of potassium, and methylconia powerfully lower reflex excitability through the cord and the great ganglia of the brain.

5. **Stomachic Sedatives.**—Irritable conditions of the mucous membrane of the stomach, giving rise to pain, vomiting, pyrosis, and other symptoms, are commonly met with, and require a considerable variety of treatment. If gastrodynia fails to yield to bismuth, soda, or hydrocyanic acid, recourse may be had to small doses of nitrate of silver or of arsenic; or blistering over the epigastrium may produce the desired effect. If vomiting be the prevailing symptom, hydrocyanic acid again proves useful, carbonic acid in the form of effervescing draughts, or minute and oft-repeated doses of nux vomica or ipecacuanha. Combined with this, we must take especial care to enjoin a mild and unstimulating dietary, of which milk and lime-water should form the principal ingredients.

6. **Vascular Sedatives.**—Vascular sedatives have the power of lowering the heart's action; and emetics and tobacco do this by the general depression following nausea and the act of vomiting. Other drugs, however, act directly on the heart itself, either by paralysing the muscular tissue of which its walls are composed, or by a more special influence over its nerve-supply. Slowing of its action may be effected either by stimulation of the inhibitory branches of the vagus, or by interference with the sympathetic ganglia which work in the opposite direction; and experiment has not in all cases made it quite clear what is the true explanation. But whatever the exact physiological explanation may be, we have some practical rules for our guidance in the use of these remedies, and more especially of digitalis, which, cardiac tonic though it be, is also a true sedative to that organ. When the heart-muscle is weak and languid, its contractions are necessarily less efficient than in health; and in order to perform its allotted amount of routine work in propelling the blood, its cavities must fill and empty more rapidly than usual. The result of this is seen in the hurried, feeble, and often irregular pulsations of the organ; and digitalis, by bracing up the muscular fibres, and giving increased tone, renders its action more efficient, and enables it to take more prolonged periods of repose. Other cardiac sedatives are aconite, veratrum viride, colchicum, and hydrocyanic acid, but they are seldom used for this purpose, although aconite, whether through its action on the heart, or on the small vessels, is very effective in early inflammatory conditions. R. FARQUHARSON.

**SELTERS, in Germany.**—Muriated alkaline table-water. *See* MINERAL WATERS.

**SEMEIOLOGY** (*σημεῖον*, a symptom; and *λόγος*, a discourse).—A synonym for symptomatology, or the doctrine of the signs and symptoms of disease. *See* DISEASE, Symptoms and Signs of.

**SEMILUNAR VALVES, Diseases of.** *See* HEART, Valves of, Diseases of.

**SENILE INSANITY.** *See* DEMENTIA.

**SENILITY** (*senex*, an old man).—SYNON.: Senile marasmus; Fr. *Vieillesse*; Ger. *Greisenalter*.

DEFINITION.—That condition of body which usually supervenes naturally after the seventieth year, but sometimes occurs prematurely.

Senility is separated from the previous period of maturity by the climacteric stage, which in men occurs between the ages of fifty and sixty, and in women about ten years earlier. When of premature occurrence this state is commonly secondary to some exhausting illness, where failure of the trophic influence of the nervous system has been marked. All the signs and symptoms of senility have been seen in individuals under twenty years old.

We do not know why the body, after it has reached a state of maturity and vigour, should gradually decline; why, when once an even balance between tissue-waste and restitution is established, it is not maintained indefinitely. How far the failure is due to some inherent tendency, and how far to external influences, is wholly conjectural. The term 'involution' has been suggested to express the progressive senile changes in the tissues and organs.

ANATOMICAL CHARACTERS.—The most universal structural characteristic of old age is a progressive *atrophy* of almost all the tissues and organs. The degree of wasting varies, but there is a general diminution in body-weight and height, except in persons whose climacteric has been marked by an increase of the adipose tissue, when the total loss of weight may be inconsiderable. Among the organs which exhibit simple atrophy in the highest degree, are the brain and spinal cord; the generative organs, especially the ovaries, and to a less extent the testes, the uterus, and the mammary glands; the mucous membrane and glands of the digestive tract; the bronchial and vesical mucous membranes; the spleen and lymphatic glands, the latter even to complete disappearance; and the kidneys. The teeth fall out; the muscles waste; and the bones become thin and deficient in animal matter, some, as the lower jaw, being much altered in shape. A most important change, and one that exerts a very direct influence on tissue-nutrition, is an extensive shrinking and even obliteration of the capillaries in almost all the textures. The skin becomes much diminished in thickness, especially in the papillary layer, the constituent papillæ being very indistinct; and loss of hair and change of colour are well-known features.

An exception to the almost universal atrophy occurs in the prostate, the fibro-muscular structures of which undergo considerable hypertrophy in most old men. The entire organ may be so affected, or only one lobe; and the weight has been recorded as attaining, in an extreme case, to 20 ounces. Very rarely the viscus wastes with age.

Associated with this atrophy it is usual to find *degenerations*—fatty, calcareous, or pigmentary—all of which are to be regarded as evidences of deficient nutrition, comparable to the differentiation and growth which characterise the commencement of life. The arcus senilis, the atheroma and calcareous degeneration of the vessels, the calcification of cartilages, the fatty degeneration of muscular and glandular epithelial tissue, the deposition of pigment in some spots, and the deficiency of the same in the hair and skin of the coloured races, are illustrations of true degenerative changes.

The products of degeneration may accumulate in the textures, and cause them to be thicker than they are in health, as is seen in the vessels, the walls of which are often much thickened, and the meninges of the brain, which are opaque and toughened. The pericardium and endocardium, and the capsule of the liver and spleen, are similarly altered.

The blood contains fewer corpuscles and less solid constituents, is more watery, and coagulates more readily. The total quantity is less.

The semen is very frequently wanting in spermatozoa, and contains in their place granular fatty cells, like colostrum corpuscles, with a few red blood-corpuscles; but this is not invariably the case, for perfect spermatozoa are occasionally met with at an advanced age.

PHYSIOLOGICAL CHARACTERS.—The results of such structural imperfections appear in deterioration of the purely physical, as well as of the specially vital, properties of the tissues. There is an increased rigidity in some parts, as the tendons and blood-vessels; and a diminished cohesion in others, as the nails and bones, which are brittle and easily broken. Perhaps the most prominent and distinguishing mark of old age is a loss of elasticity; the skin, cartilages, blood-vessels, and lungs show this to a very marked extent, in the wrinkled integuments, dilated vessels, and distended air-cells. It has been noticed that this dilatation particularly affects the thin-walled veins, and more especially those which do not run with arteries, are more superficial in position, and are concerned less with nutrition than with the proper return of blood—the 'derivative circulation' of Sucquet. The advantage of this is apparent, for such an arrangement must be a safety-valve in the case of the brain, to which organ there is a liability to determination of blood, and where the vessels are apt to rupture; hence the frequent turgescence of the nose and ears, and development of the veins of the diploe, in the aged. The muscular contractility and nervous irritability are diminished; and degeneration of the cells of glands leads to failure in their powers of secretion.

The heart's beat is weak, and frequently intermittent, from defect in rhythmical nervous stimulation; the sounds are feeble and often altered; and there is a general tendency to venous congestion. The mean rate of pulse after the age of sixty-five years is 75, gradually diminishing to 70.

The tissues, which differ in chemical composition from those of mature life, must in their

metabolism form different products of waste; whilst the altered blood, circulating in a restricted area with diminished force, must offer to the organs a different pabulum from that which they have hitherto received, supplied as it is by impaired digestive organs. The enfeebled respiration prevents complete oxidation; and the excretory organs, being degenerated, withdraw from the body less perfectly the results of metamorphosis. The quantity of urine is often diminished to 15 or 20 ounces *per diem*, in old men enjoying good health. It contains a total amount of solids less than the normal standard, but the urine itself may be relatively of higher specific gravity, and deeper colour, from its diminished quantity.

As the nutritive functions fail, so do those of the neuro-muscular system. The sense-organs imperfectly receive impressions, which are but dimly communicated to the sensorium, whence feebly emanate the impulses needful to determine movements in muscles whose protoplasmic contractility is gradually diminishing. Meanwhile the higher mental qualities, such as memory, judgment, and reason, dependent as they are upon the most perfect nutrition, gradually fail. The opposite conditions of wakefulness and drowsiness are frequently met with, and seem to be due to brain-wasting, as well as to some change in the cerebral circulation.

Notwithstanding the lowered vitality, the average body-temperature is slightly higher than it is in adult life, but the power of resisting cold is diminished.

The power of reproduction, lost by women at the climacteric, before the stage of senility sets in, is occasionally preserved by men to an advanced age.

Thus the old man presents a strong contrast in his vitality to that of the child, for whilst the life of the latter is so largely dependent upon, and so readily responsive to, external or peripheral impressions, the former lives more and more within himself; the distinctive animal functions gradually failing, as his existence becomes restricted to the performance of those of self-nutrition. The progressive impermeability of the capillaries, and the lessened vitality of the skin, alike tend to withdraw from the surface towards the central organs the manifestations of life.

**Diseases of Old Age.**—In a certain number of cases, the progressive deterioration in structure and failure in functional capacity mutually adapt themselves, and produce an old age which may be as healthy as the maturity or childhood may have been. But in the course of the changes which mark this period, the body is liable to certain influences, both intrinsic and extrinsic, which lead to diseases characteristic of this stage of life, as there are those of infancy and puberty. Death from old age, when the organs have gradually and uniformly failed, is not unknown, but the fatal end is more commonly due to some disease, which has either lasted from an earlier period, or is especially the acquirement of this stage.

The maladies particularly characteristic of old age are marked by certain general features, which they owe to that condition of nutrition in which the tissues are at this period. Thus, as a rule, they present but little activity in their progress, or but slight severity in symptoms, though they are none the less likely to bring about a fatal result, from the ill-resisting power of the whole system. Diseases of an acute character are rare at this time, and such as do occur assume an adynamic form and are very liable to run a most insidious and even latent course. When once established, an illness tends more perhaps towards maintaining an isolated attitude, without those sympathetic disturbances of many other organs so pre-eminently the case in children. The power of reaction possessed by the aged is but very slight; owing to this, diseases readily lapse into a chronic state, or even present a chronic character from the outset, whilst comparatively trifling causes may lead to serious results.

There is probably no single disease which is met with in advanced age only; rather is it the case that many diseases which prevail at certain periods of life are wanting in old age. The degeneration of every tissue and organ entails a failure in function; and should this failure predominate in any one system, we have some exception to what may be taken as the normal standard of the senile state, and therefore a disease of it. The same difficulties surround the question why one set of organs should be affected rather than another, as at other ages; but there nevertheless does exist a preference towards affections of the brain, heart, and lungs.

*Diseases of the brain.*—The cerebral lesions may be a general senile wasting and softening, with complete enfeeblement of nerve-function; or of a more localised character from rupture or occlusion of some vessel. The liability to venous engorgement is very prone to manifest itself in the brain, and cerebral congestion of varying extent is frequent. The cerebral vessels are especially prone to atheromatous changes, and hence the great frequency of apoplexy in old age. The meninges are free from morbid change beyond thickenings, and offer none of the inflammatory conditions so common in early life.

*Diseases of the heart.*—The degeneration of the cardiac substance may lead to a state of asthenia, gradually becoming fatal; dilatation of the orifices may be the more prominent lesion, with all the consequent symptoms of obstructed circulation; or they may be constricted, from atheroma or thickening of the cusps or rings. All degrees of cardiac dyspnœa are met with; and every form of irregularity in cardiac rhythm.

*Diseases of the lungs.*—Pulmonary diseases are important, since they are commonly the immediate causes of death in the aged. A bronchial catarrh, or at least a considerable increase in the bronchial secretion, is a normal state in the very old; and this has been regarded as a compensation for the arrested skin-action. The transition from this to severe bronchitis is both easy and frequent, and is favoured by the liability to lung-congestion, and the enfeebled heart-power. Even more serious is a senile form of lobular pneumonia, which seems to be set up in the congested and œdematous areas, possibly as a further stage of the bronchitis. Such pneumonia is of very frequent occurrence, and often requires care-

fully looking for, since direct symptoms are wanting. When a generally ill-defined illness is present in an old person, this condition should be suspected.

*Diseases of the digestive organs.*—The digestive organs, supposing they have escaped the dangers of earlier periods, are not often the seat of disease at this time of life. The perversions of function they present, such as constipation and flatulence, may be conveniently comprised under the term atonic dyspepsia, and are mainly to be attributed to deficient muscular power in the alimentary canal, and to a deficiency in the digestive fluids. Nevertheless, a good appetite and very fair digestion are far from being the exception in old people. An acute form of diarrhœa of a dysenteric character has been described as occurring at this period.

*Diseases of the skin.*—The skin, which suffers so much diminution in nutrition and thickness, often exhibits as a result marked changes in sensibility, even to the existence of an intolerable pruritus, no cause for which is visible. The scratching which is resorted to for relief sets up a prurigo which intensifies the discomfort. The unhealthy integument offers a very favourable nidus for pediculi, and phthiriasis is accordingly a common senile affection.

*Diseases of the urinary organs.*—Recent observations go to show that the senile kidney is in a condition of diffuse interstitial nephritis, with progressive atrophy of the tubes, similar in many respects to the 'gouty kidney,' but not, like it, associated with cardiac hypertrophy. The urine is in such cases albuminous, but the general symptoms of Bright's disease met with in middle life are usually wanting. Glycosuria, often intermittent, is of very frequent occurrence in old people; but is rarely attended by the constitutional disturbance of diabetes. Notwithstanding the very imperfect action of the skin and kidneys as excretory organs, diseases directly attributable to non-elimination of waste-products are not characteristic of old age, except, of course, so far as helping in the general degeneration.

Irritability of the bladder, or even vesical catarrh, is very common in old men, being largely determined by the prostatic enlargement; and both retention and incontinence of urine follow, from the diminished tone of the viscus.

*Vascular disease.*—The tendency of the blood to coagulate, added to the opportunities it has for stagnating in the dilated channels and cavities of a weak heart, makes thrombosis and embolism characteristic lesions of the senile state. The result of the obstruction is gangrene (*gangræna senilis*), which is readily established in tissues the capillaries of which have wasted or are obliterated, with corresponding deficiency of nutrition.

*Arthritic lesions.*—Very few old people escape chronic rheumatism in one or other of its many forms. The fibrous tissues of the joints, fasciæ, and tendons are thickened, with the result of producing that stiffness of the limbs so characteristic of the aged. The pain is rarely acute, but it is lasting, and aids in bringing about the general deficiency of motor power. Renal disease is to be found in a large proportion of these cases. True gout is scarcely a disease of old age, though often continued on from an early period of life.

*Scrofula, Cancer, and Syphilis.*—Sir James Paget refers to a senile form of scrofula occurring in people over sixty years of age, in whom the constitutional signs have appeared in early life, with almost complete freedom during maturity. He describes the general features of this condition as being similar to those in childhood, but slower in their course, and more complete in the degeneration produced. The cancerous and syphilitic cachexiæ very rarely manifest themselves for the first time in old age.

Treatment.—Old age itself, as a period of life, is clearly no more to be treated as such than life at any other stage. But regarded as a marasmus or cachexia, it has been sought to avert it as long as possible, or mitigate its effects; and for the attainment of longevity many means have been proposed, though as yet without any reliable result, the most diverse plans having been equally successful or futile. *See* Personal Health.

It is unnecessary in the present article to explain the treatment of the diseases of old age, as appropriate remedies are set forth under the special headings. It is sufficient here to indicate that, whatever may be the malady, and whatever be the treatment pursued, it must not be forgotten that we are dealing with organs in which the structure is deteriorating and whose vitality is failing, and that all measures of a depleting or depressing character must be avoided. The patient must be nourished in every way by food, stimulants, tonics, and such remedies; and this rule must not be departed from on any account. The power of secretion being so diminished, the efficacy of drugs is often lessened, and their good effects but imperfectly manifested. Among the most important hygienic indications is the maintenance of warmth. A fall in temperature both lowers the general vitality, and establishes a local disease, and its effects are more easily prevented, than cured when once established.

W. H. Allchin.

**SENSATION, Disorders of.**—The sensory apparatus—consisting of, 1st, a peripheral end-organ for receiving impressions; 2nd, an afferent nerve which conducts them; and, 3rd, a ganglionic nerve-centre which undergoes a change, perceived by the consciousness as a feeling—may be disordered in various degrees. The lesion occasioning the disorder may exist at any point of the apparatus. As regards (A) the nerves of *special sensibility*—the olfactory, optic, auditory, and gustatory, the terms *hyperæsthesia* or *excess of feeling*, and *anæsthesia* or *want of feeling*, are applied respectively to conditions of exaggerated or defective sensibility. In reference to (B) the remaining sensory nerves, the perceptions produced by which are known as *common sensations*, the same terms are used, as well as certain others indicating perversions of sensibility, which can scarcely be included in this simple classification. There is a good deal of confusion existing in the employment of these terms, and their use can only be defended on account of their possessing a certain amount of convenience for purposes of distinction. *Pain* is separately described. *See* Pain.

**A. Special sensibility.**

1. *Olfactory hyperæsthesia.* This is probably always of central origin. It is shown by subjective sensations of strong, usually disagreeable, odours; and occurs occasionally in the insane and epileptic, as well as in hysteria.

2. *Olfactory anæsthesia.* Synon.: *Anosmia.*—This is occasionally congenital, but otherwise rare, and (unless where the mucous membrane of the nares has been destroyed by ulceration) is usually dependent on disease of the brain, or growths upon the olfactory lobes. It may also arise from laceration of the olfactory filaments, as a result of *contre-coup* in blows upon the occiput. There may be complete anosmia, whilst the common sensibility of the nares is retained. On the other hand, in peripheral lesion of the fifth nerve there may be partial loss of smell, owing doubtless to impaired nutrition of the nasal mucous membrane. Integrity of the mucous membrane is apparently necessary (probably for mechanical reasons) to the perfect functioning of this special sense. It sometimes happens that there are subjective sensations of bad odours, where the power of perceiving objective odours is absent. Anosmia may occasionally result from a long-continued nasal catarrh, and is then probably connected with some modification of the mucous membrane which receives olfactory impressions.

3. *Optic hyperæsthesia.*—This disorder is marked by the production of luminous and chromatic sensations, independent of external influences. The disordered function may be caused by, or associated with, coarse disease of the brain, over-stimulation of the optic nerve by light, insanity, delirium tremens, epilepsy, or hypochondriasis. Spectra of luminous angularities, resembling the lines of fortifications, showers of sparks, or bright colours occur sometimes in the course of migraine. A subjective sensation of colours (most often red) occurs occasionally as the aura of an epileptic fit.

4. *Optic anæsthesia.*—This may depend upon changes in the retina, in the trunk of the optic nerve or tract, or in the nervous ganglia which form its central termination. The terms *amblyopia* and *amaurosis* are usually employed to designate different *degrees* of imperfect vision, the latter the most advanced. *Amblyopia* is often met with in the disused eye in cases of strabismus, without any structural change being necessarily capable of detection by the ophthalmoscope, such as would explain the loss of nervous sensibility. In some instances, however, of this kind, the optic disc has a shrivelled, ill-nourished look; it is dull; and the retinal vessels are small. Amblyopia may consist in a general obscurity of vision, a deficiency in the power of definition, a contraction of the field of vision, or anomalies of colour-vision. It occurs occasionally in hysterical hemianæsthesia, and is then limited to one eye, on the same side as the other defects of sensation; it is frequently the prelude of an epileptic fit.

Ophthalmoscopical examination of the eye, together with the patient's general condition, will usually reveal the cause with facility. *Amblyopia* may be a symptom of *optic neuritis.* The optic neuritis will probably be dependent upon tumour, abscess, aneurism, or some coarse change within the cranium, such as meningitis. Or there may be *neuro-retinitis*, in which the retina still more largely participates in the inflammatory changes, a condition liable to be induced, amongst other causes, by syphilis, diphtheria, or over-lactation. But the symptom is frequently absent in both conditions up to a certain point, the patient being able to read small print even when the pathological changes are strongly pronounced. Sometimes amaurosis also occurs in diabetes, from retinal changes. In *hemeralopia* there is retinal torpor, which is sometimes not accompanied by any manifest structural change. The disorder is connected with anæmia, impaired nutrition, and various causes of exhaustion, and is especially common in scurvy. It may occur in Bright's Disease, but is here found associated with hæmorrhages and other changes characteristic of albuminuric retinitis.

5. *Hemiopia.*—This is a condition in which a half of the field of vision—usually a lateral half—is cut off. It may depend upon coarse disease, such as a tumour or clot, pressing upon an optic tract. It occurs sometimes in hemiplegia, complicated with paralysis of the third nerve opposite to the side on which the limbs are paralysed, and depends then upon lesion of the corresponding crus cerebri. It is frequently seen in a hemiplegia which is attended with strongly marked and persistent anæsthesia of the affected limbs, and dependent upon coarse disease in the neighbourhood of the optic thalamus. It is not rarely met with also, but only as a transient symptom, in migraine. It is occasionally, but only seldom, met with in hysteria.

6. *Auditory hyperæsthesia.*—In certain states of nervous exhaustion in fever, and sometimes in hysteria and hypochondriasis, sound-producing vibrations painfully affect the auditory nerve. It is doubtful whether the proper function of the nerve is ever really much intensified. Pain, rather than an increased power of hearing, is the result of hyperæsthesia of the auditory nerve.

7. *Tinnitus aurium.*—This is almost always subjective, although it must be borne in mind that an aneurism in the neighbourhood of the temporal bone may occasion this condition, and this may possibly give evidence of its presence on auscultating the skull. The sounds may be of various kinds—rumbling, musical, roaring, hammering—and may depend either upon some irritation of the auditory nerve itself, or upon affection of some other part of the organ of hearing. It seems probable that affection of any portion, from the external auditory meatus to the Eustachian tube, may give rise to the condition. The difficulty of diagnosing the seat of the affection is very great.

Tinnitus aurium may also be dependent upon some altered condition of the walls of blood-vessels, in connection with anæmia or cerebral congestion. It is often produced by large doses of quinine. In certain cases it is of central origin. The sensation of a loud noise occasionally marks the commencement of an epileptic seizure or of a syncopal attack. Deranged digestion may produce it. There may be subjective sensations of sound in an ear which is quite deaf to external impressions.

Careful examination of such parts of the auditory apparatus as can be reached should be made,

ere a conclusion is come to respecting the origin of tinnitus aurium in a particular case. It is not uncommonly found to be dependent simply upon an accumulation of wax in the external auditory meatus. Tinnitus aurium is very often associated with vertigo. Not uncommonly occurring in persons of gouty habit, it is possibly caused, in such cases, by some deposit in a joint of the ossicles, causing inflammation and stiffness.

Tinnitus aurium is always a distressing, and often an intractable, affection. Where it depends upon some anæmic condition, it is most likely to be cured by remedies appropriate to this state. Of course, if caused by accumulation of wax, the removal of this is a simple remedy. Subjective sensations of sounds, especially of voices of men or animals, occur frequently in various forms of insanity, in which case they are spoken of as hallucinations.

8. *Auditory anæsthesia.*—This may be due to disease or suspended functional activity of the auditory nerve; and probably, in some cases, to lesion of the superior temporo-sphenoidal convolution of the brain—Ferrier's centre for hearing. Hardness of hearing and deafness are the forms taken by varying degrees of acoustic anæsthesia. The cause may be disease in the osseous labyrinth of the bone itself or its lining membrane, or tumours which cause compression and atrophy of the nerve, basilar meningitis, extravasations, or new formations. Syphilis may bring about acoustic anæsthesia by causing periostitis and consequent pressure upon the auditory nerve. A most fruitful source of deafness is disease of the temporal bone from scarlatina. In some instances the auditory nerve is atrophied, as part of that generalised disorder of the sensory nervous system which is called locomotor ataxy. In cases of so-called nervous deafness enquiry should be made as to the occurrence of 'lightning pains,' and the state of the patellar tendon reflex should be investigated.

Disease of the pons Varolii or medulla oblongata may occasion deafness, through lesions affecting the nucleus of the auditory nerve or the commencement of its trunk. It is more likely than not that in these circumstances the auditory nucleus would not suffer alone, but that there would be evidence of other cranial nerves being involved, which would aid the diagnosis.

9. *Gustatory hyperæsthesia.* — This disorder occurs probably only in the course of mental and epileptic disorders, where the subjective sensation of a taste (most often perhaps of an offensive character) is sometimes complained of. Such a condition is of central origin.

10. *Gustatory anæsthesia.*—This is of frequent occurrence. There may be a total inability to appreciate the taste of substances applied to the tongue, or more or less delay in their recognition. It is sometimes observed in cases of peripheral paralysis of the facial muscles, and then depends upon the lesion of the portio dura involving the chorda tympani. It is the anterior portion of the tongue which, in such circumstances, exhibits the loss of function. So also in disease of the trigeminus in the floor of the skull, there is frequently gustatory anæsthesia in the anterior portion of the tongue. The glosso-pharyngeal nerve by its terminal branches presides over the sense of taste in the posterior third of the dorsal aspect of the tongue. Disease or lesion of the trunk of this nerve destroys the sense of taste in this region. *See* TASTE, Disorders of.

The disorders of special sensation which we have described are so bound up with lesions of the various nerves subserving the functions, or of the nervous centres, that they can only be considered from an ætiological and therapeutical point of view in connection with these. Reference must, therefore, be made to the sections devoted to such lesions.

B. **Common Sensibility.**—Disorders of those centripetal nerves, the perceptions produced by which are known as 'common sensations,' are considered under the head of TOUCH, Disorders of.

T. BUZZARD.

**SEPTIC** (*σήπω*, I make rotten or putrid; I make fester or mortify.)—This word is used with some vagueness. It has been employed in both the senses indicated by the derivation, that is, either as merely synonymous with putrid, or as signifying some special or even specific virulence in decomposing matter. The confusion will be better understood by referring to the definition of SEPTICÆMIA. There is no doubt the word had better be abandoned, and *putrid* used in its stead; or else that it be clearly understood to have no meaning beyond putrid.

MARCUS BECK.

**SEPTICÆMIA** (*σηπτικὸς*, putrid, and *αἷμα*, blood).—SYNON.: Fr. *Septicémie*; Ger. *Septicämie.*—This term properly means the condition produced by the entrance of septic matter into the blood. Great confusion has, however, been caused by using it to signify two entirely distinct conditions. The first of these cannot be better defined than in the words of Dr. Burdon Sanderson, in his Lectures on the 'Infective Processes of Disease' (*Brit. Med. Journ.*, Dec. 29, 1877). He says: 'What I mean by *septicæmia* is a constitutional disorder of limited duration, produced by the entrance into the blood-stream of a certain quantity of septic material. It must, therefore, be regarded, not so much as a disease as a complication, differing from pyæmia, not only in the fact that it has no necessary connection with any local process, either primary or secondary, but also in the important particular that it has no development. Pyæmia is a malignant process which goes on and on to its fatal end; but in the case of septicæmia, inasmuch as the poison which produces it has no tendency to multiply in the organism, there is no reason why the morbid process should not come to an end of itself, unless either the original dose is fatal, or a second infection takes place from the same or another source.' The process here described is merely poisoning by the absorption of the chemical products of putrefaction. It is no more an infective process than the poisoning that would result from the application of arsenic, mercury, or any other inorganic substance to a raw surface.

On the other hand, Koch of Berlin, Davaine, and many others include under the term septicæmia all those cases of general infection from a wound in which no metastatic inflammations are present. Koch especially describes as septi-

cæmia in mice a disease in which, as the result of the inoculation of an infinitesimal dose, the animal dies within a certain period, without the formation of any secondary local centres of inflammation. The blood, however, is so completely impregnated with the poison that merely scratching the ear of another mouse with a needle dipped in the opened heart of the first, is sufficient to start a similar process in that animal, and so on indefinitely. In this case the process is truly infective, and the poison multiplies in the body of the animal. The poison has been shown by Koch to consist of a distinct form of microscopic organism.

These two conditions must be kept distinct if we are to avoid confusion. In both forms the development of the poison is associated with putrefaction, in the first necessarily, in the second accidentally. The former is an inevitable consequence of the entrance of the products of putrefaction into the circulation; the latter can only occur if the specific organism, which is the cause of it, should happen to find a place amongst those which are necessarily associated with all putrefactive changes. The latter also, although usually originating in conjunction with what we ordinarily speak of as putrefaction, can be transferred from animal to animal by inoculation, without the intervention of any putrefactive process whatever.

If, therefore, we use the word *septic* as meaning no more than putrid, the two conditions indicated above, at present often indiscriminately spoken of as septicæmia, may be defined as follows:—

*Septic poisoning.*—The effects produced by the absorption of a poisonous dose of the chemical products of putrefaction.

*Septic infection.*—An infective disease caused by the entrance into the blood, and by the multiplication therein, of a specific organism most commonly developing in wounds or cavities, the fluids of which are at the same time in a state of putrefaction.

It must be understood that this article is merely intended to indicate the meanings of the word *septicæmia*. The fuller discussion of the subject comes under Pyæmia. *See* Pyæmia.

Marcus Beck.

**SEPTUM CORDIS, Deficiency of.** *See* Heart, Malformations of.

**SEQUELÆ** (*sequor*, I follow).—Consequences or sequels. This word is applied to symptoms or morbid conditions which either remain or supervene after various diseases have run their course; such as renal disease after scarlatina, paralysis after diphtheria, or cardiac disease after acute rheumatism.

**SEROUS CYST.**—A cyst containing serous fluid. *See* Cysts.

**SEROUS FLUID**
**SERUM** } In physiology the liquid portion of the blood, which separates after coagulation, is named *the serum*, and this is taken as a type of fluids of more or less similar composition, consisting of a watery solution of albumin with certain salts. In pathology we have to deal with serum outside the blood-vessels, either as a mere dropsical accumulation, or as a consequence of inflammation. It may be thus met with in the cellular tissue under the skin or a mucous membrane, and in other parts; in serous cavities; in certain organs, as the lungs and the ventricles of the brain; or as a discharge from the surface of the skin, as in cases of eczema. Its precise composition varies considerably under different circumstances. Clinically serous fluid is, as a rule, of most importance on account of its mechanical effects, when it accumulates in quantity in various parts, and these effects may be most serious. Its presence can usually be detected by objective or physical examination. The treatment required will be either that for dropsy or inflammation, modified by local considerations, according to the principles laid down in other special articles.

Frederick T. Roberts.

**SEROUS MEMBRANES, Diseases of.** Synon.: *Maladies du système séreux*; Ger. *Krankheiten der Serösenhäute.*—These constitute an important class of diseases, and although they are discussed under the headings of the several serous membranes, it will be advantageous to consider them generally, according to the plan followed in the case of the mucous membranes. These membranes line closed cavities, except the peritoneum in the female, which communicates with the uterus through the Fallopian tubes, and thus with the exterior of the body. They consist of a basement-membrane, covered with epithelium, usually of the scaly variety, and a subserous cellular tissue underneath. In addition to their more obvious function, of allowing free movement for organs, they are intimately connected with the absorbent system, the vessels of which freely open on their surfaces. Fibro-serous membranes constitute a variety in which there is an outer fibrous covering, lined by a serous layer, of which the pericardium is an example. These introductory remarks will clear the way for the consideration of the nature and causes of the diseases of serous membranes, which will now be pointed out.

1. **Injury.**—The serous membranes are liable to be injured from without, chiefly as the result of wounds penetrating the cavities which they line, but also by fractured bones, especially in the case of the ribs and skull. It is believed that a severe external contusion may affect an underlying serous membrane. Another important cause of injury to these structures is some perforation or rupture taking place within the body (*see* Perforations and Ruptures). They are frequently more or less injured in various operations. Any kind of injury to this class of membranes was formerly regarded with great dread, and operations in which they were in any way interfered with were considered highly dangerous; more recent experience has, however, shown that mere damage to a serous membrane is not serious in itself. More or less grave consequences are liable to follow, from hæmorrhage; from the admission of air, especially if it contains septic matters; or from the escape of solid or liquid materials into a serous cavity. In addition to their direct effects, these often set up inflammation, which may prove fatal.

2. **Inflammation.**—Serous inflammations are

of common occurrence, and without entering into details, their causes may be thus summarised: (*a*) Some injury from, without including that set up by fractured bones. (*b*) Perforations and ruptures within the body, the inflammation being then mainly due to the materials which gain access into the serous cavity. (*c*) Mechanical or chemical irritation of any kind. Many cases belonging to the former groups would come under this one; as well as those in which inflammation is set up by necrosed bone, diseased organs, and tumours, or as the result of over-distension of a serous membrane. This class would also include those cases in which a serous inflammation is purposely excited by the injection of certain chemical irritants. The occurrence of peritonitis from the entrance into the peritoneum of materials from the uterus may also be mentioned here. (*d*) Morbid growths in connection with a serous membrane. These deserve separate mention, though they likewise act by causing local irritation. (*e*) Extension of inflammation from other structures. In this way the morbid process may pass from one serous membrane to another. Serious forms of inflammation may probably extend to the serous membranes by means of the lymphatics. (*f*) Certain general states of the system, in connection with low fevers, Bright's disease, and other affections. (*g*) Causes acting upon the general system from without, such as cold, when the inflammation is said to be *idiopathic*. Different serous membranes present different degrees of liability to be affected by one or other of the causes mentioned; and these produce different effects, according to their nature.

Cases of serous inflammations present much diversity as regards their severity and rate of progress, and the morbid changes are thus materially influenced in their character, as well as by the cause of the inflammation, the particular membrane affected, and other circumstances. In general terms they may be grouped as *acute*, *subacute*, and *chronic* in their origin and course; but those which are more or less acute at first often leave behind permanent morbid conditions. Taking an ordinary case of an acute serous inflammation, running a regular course, it presents the following more or less obvious stages in its anatomical characters:—(*a*) Increased vascularization, consequent redness of the membrane, and sometimes small hæmorrhages, accompanied with dryness, loss of polish, opacity, and swelling. (*b*) Deposit of organisable lymph or fibrinous exudation upon the surface, containing a variable number of cells. (*c*) Effusion of fluid into the serous cavity, more or less of the nature of serum, but also containing a variable proportion of fibrin and cells. (*d*) Absorption of the fluid. (*e*) The formation of fibrous thickenings, or of adhesions, bands, or agglutinations between the opposing surfaces of the serous membrane.

Such being the usual course of events in a typical case of serous inflammation, it must suffice to point out, without entering into any details, some of the more common variations. There may be little or no fluid, the exudation being the prominent morbid product. This exudation varies much in its quality, and may be of a very low, unorganisable type, resembling in some instances thick pus. Again, the effusion is, under certain circumstances, liable to become sero-purulent or actually purulent, or it may be so from the first. In other conditions it is hæmorrhagic. Its quantity is very variable. There is a class of cases in which the prominent morbid change is the accumulation of a serous effusion, not uncommonly in large amount, and it may take place very gradually and insidiously. The slow and chronic formation of localised adhesions is very common in connection with serous membranes, without any clinical indications of their development. Gas may be present in serous cavities in cases of inflammation, and then results secondarily from decomposition of the effusion. In rare instances pus collects in the subserous tissue; or actual destruction or gangrene may occur.

With regard to the extent of the disease, cases of serous inflammation are usually divided into *general* or *diffuse*, and *local* or *circumscribed*, though the former terms do not necessarily imply that the whole of a serous membrane is implicated. As a rule the effusion is freely movable in the cavity, but it may be more or less limited by former adhesions, or even completely loculated and encysted. Serous inflammations are often accompanied with changes in the organs and structures which they cover, these being either the cause or effect of such inflammatory changes. Moreover, an effusion, especially if purulent, may open in various directions, and thus originate secondary consequences more or less serious. Not uncommonly it has to be removed by operation.

Pathologists are not quite agreed as to the microscopic changes which take place in inflammation of serous membranes, but the following are the chief points to be noticed. The epithelium undergoes marked changes, its cells usually becoming enlarged and swollen, granular, and cloudy, whilst its nuclei divide and multiply, and active proliferation goes on. In low forms they merely undergo fatty degeneration and destruction, and are shed abundantly. The fibrin escapes from the blood-vessels, and migration of corpuscles also takes place. The cells in the substance of the serous membrane, and the connective-tissue corpuscles proliferate more or less. Vascular granulations often form on the surface, which are believed to be of much service in absorbing the effusion, as well as in forming adhesions. Pus-cells are derived from the epithelium, and from migration. Adhesions ordinarily result from the development of the cellular elements in the exudation, the fibrin undergoing fatty degeneration; after pus is formed they originate by granulation. In these adhesions blood-vessels, elastic fibres, lymph-chambers, and even nerves may ultimately be developed.

3. **Dropsical Effusion.**—The serous cavities are often the seat of a mere dropsical accumulation, owing to the escape of fluid of a more or less serous character from the vessels. It may be in very large quantity, and collect either rapidly or gradually. Sometimes it is not easy to draw the line between an inflammatory and a dropsical effusion; and it is probable that the latter, by distending a serous membrane, may really set up a secondary inflammatory condition. The fluid is occasionally blood-stained. The condition may be entirely local, or a part of a more

or less general dropsy. It may arise from:—(*a*) Local obstruction to the venous circulation, which is best exemplified by ascites associated with portal obstruction. (*b*) General obstruction to the circulation, in certain cases of cardiac and pulmonary disease. (*c*) Bright's Disease. (*d*) Chronic adhesions and thickenings originating in past inflammation; and morbid growths, such as tubercle or cancer. These probably act by pressing upon the small vessels. (*e*) Exposure to cold, sudden suppression of chronic skin-diseases, and other causes which are supposed to originate active internal congestion.

4. **Hæmorrhage.**—As has been already stated, more or less blood may be present in inflammatory or dropsical effusions in serous cavities. As a distinct morbid condition, hæmorrhage into these spaces may be due to:—(*a*) External injury. (*b*) Rupture of an organ, whether healthy or diseased. (*c*) The bursting of an aneurism. (*d*) The rupture of vessels in connection with some morbid growth, especially cancer. (*e*) Purpura and scurvy in exceptional cases.

5. **Accumulation of Gas.**—This condition, in connection with serous cavities, may result from:—(*a*) Decomposition of inflammatory products, or of gangrenous materials. (*b*) Perforation or rupture of a hollow organ containing air or gas, whether due to external injury, or originating from within. This accounts for most cases of escape of air into the pleura from the lung, and of gas from the intestine into the peritoneum. (*c*) Transmission of gas through the walls of a hollow viscus into a serous cavity, which sometimes happens in the case of the intestine. The gas varies much in its composition, according to the cause of its presence, and its seat. In pneumothorax it is usually modified air; in pneumoperitoneum it is offensive and fœtid. Not unusually the gas is associated with inflammatory effusion or other materials; or it may set up inflammation, and cause effusion.

6. **Foreign Materials.**—Various objects may be found in serous cavities, either introduced from without, as the result of injuries; or having entered from internal organs, especially in the case of the abdomen. Amongst others may be mentioned dirt, bullets or shots, food, fæces, urine, worms, and calculi. These are very liable to set up inflammation, often of a very severe and dangerous character.

7. **Morbid Growths.**—Tubercle and cancer are the two important growths which may be found associated with serous membranes. In the folds of the peritoneum accumulation of fat often occurs. Amongst rare morbid formations may be mentioned hydatids; cysts of different kinds; fibromata; myxomata; and remnants of blood-clots. They may produce inflammation or mere serous effusion.

8. **Malformations.**—The serous membranes sometimes present unusual arrangements, especially the peritoneum, and these may become of clinical importance.

Symptoms.—The clinical phenomena which are associated with diseases of serous membranes come within very defined limits, and can be readily understood, as the following outline will show.

1. *Morbid sensations.*—Pain is usually a prominent symptom in acute serous inflammations It is not uncommonly very severe; variable in its character, but often sharp and darting; subject to exacerbations; and increased by any movement or action which disturbs the inflamed membrane. Where the membrane can be affected by pressure, as in the case of the peritoneum, marked tenderness is observed, and it may become extreme. It must be remembered, however, that pain is not a necessary accompaniment of acute serous inflammation. In connection with adhesions and thickenings, painful sensations may be experienced, owing to the implication of branches of nerves; and also in other conditions associated with chronic inflammation. Another kind of morbid sensation, often felt in diseases of serous membranes, is that of distension or fulness, due to various accumulations in their cavities.

2. *Effects on neighbouring structures.*—These account for most of the prominent symptoms associated with diseases of serous membranes. (*a*) Acute inflammation will at first cause irritation of certain muscular organs, such as the intestines, bladder, or heart, and thus excite or disturb their actions. A similar effect is liable to be produced on the brain and spinal cord. Subsequently these organs tend to become weakened, or even paralysed, owing to their tissues being involved in the inflammatory process; and thus striking, or even dangerous, symptoms may arise. (*b*) The various accumulations in serous cavities produce more or less mechanical effects, often of great importance, especially if the accumulation take place rapidly. The most evident are distension of the walls of cavities lined by serous membranes; compression of organs and tubes, as of the lungs; displacement of various structures; and embarrassment of the action of organs, such as the heart and lungs. In these several ways not only may subjective sensations be produced, but different objective phenomena, which may prove very serious, or even fatal. In the case of the arachnoid, lymph may affect important nerves, by enclosing and compressing them. (*c*) Another important class of symptoms are those due to the effects of adhesions, agglutinations, thickenings, or morbid growths. Thus organs may be fixed in abnormal positions, their actions interfered with, different structures directly pressed upon, or hollow organs strangulated and obstructed. *See* Adhesions.

3. *Ruptures and discharges.*—Accumulations in serous cavities may rupture in various directions, and in this way originate symptoms. If they burst internally, they will also probably set up secondary lesions, with their corresponding phenomena. When liquid accumulations open into organs which have an external communication, such as the lungs or intestines, they are discharged. They may also burst externally, either directly, or after having first made their way into the subcutaneous tissue.

4. *Physical signs.*—These are of great importance as clinical indications of morbid conditions of most of the serous membranes, of which they may be the only evidence. They are described in other appropriate articles, and it must suffice to state here that they reveal one or other of the

following conditions:—(*a*) Some deposit upon, or roughness of, the surfaces of the membrane, associated with inflammation or morbid growths. (*b*) Accumulation of a fluid, of whatever kind, and whether freely movable in the cavity or localised. (*c*) A collection of gas, or of gas and fluid together. (*d*) Adhesions or agglutinations. (*e*) The presence of solid masses, due to inflammatory thickening, or to morbid formations, especially cancer. (*f*) Physical effects produced on organs by the abnormal state of the serous cavities.

5. *General symptoms.*—The system is liable to suffer in different ways in cases of disease of serous membranes. Thus syncope, shock, or collapse may occur in connection with injuries and hæmorrhages. Inflammation causes pyrexia, usually varying much in degree, but in some instances very high. Septicæmia may arise from the absorption of inflammatory products of low type; and collapse occurs in many cases of peritonitis. Signs of the general cachexia may be present in cases of cancer or tuberculosis.

Treatment.—It is scarcely practicable to give any serviceable general outline of treatment directed to diseases of serous membranes, this being so much influenced by a variety of circumstances. In the large majority of cases the measures adopted have some relation to acute inflammation, being intended either to prevent, limit, or subdue this process; to get rid of its products, either by absorption or in other ways; to obviate or relieve its effects upon organs and other structures; to alleviate symptoms; and to affect the general condition. Attention may also have to be directed to the after-effects of inflammation, in the way of adhesions, or to similar conditions arising from chronic inflammation. In a considerable group of cases the object of treatment is to endeavour to remove accumulations, especially of fluid, from serous cavities, whether of inflammatory or other origin. For this purpose it is not uncommon at the present day to resort to operative interference, by means of aspiration, tapping with the trochar and cannula, and other methods. General and local rest are often of much service in the treatment of morbid conditions connected with serous membranes; and local applications are also frequently useful for various purposes. Bleeding, either general or local, has been extensively practised, and is still, in the treatment of serous inflammations, and also the exhibition of calomel and opium; but, in the writer's opinion, the routine adoption of this line of practice cannot be too strongly deprecated. Medicines and local measures which tend to promote absorption are often of decided value, especially in the case of inflammatory or dropsical effusions.

Frederick T. Roberts.

**SERPIGINOUS** (*serpo*, I creep).—This term is used in connection with certain morbid conditions, such as ulcers or eruptions, when they spread in a creeping manner.

**SETON, Use of.**—A method of counter-irritation, which consists in the insertion of a tape or cord beneath the skin. *See* Counter-Irritants.



**SEVENTH NERVE, Diseases of.** *See* Facial Paralysis; Facial Spasm; Hearing Disorders of; Salivation; and Taste, Disorders of.

**SEVILLE, in Spain.**—A variable, rather bracing, inland winter climate. *See* Climate, Treatment of Disease by.

**SEXUAL FUNCTIONS IN THE FEMALE, Disorders of.**—Introduction.—The influence of the sexual functions on the general health is alluded to in the article Puberty, Disorders of. But, as the ætiological importance of the reproductive system is by no means limited to that period, we may here briefly consider the effect of sexual disorders generally on the bodily health.

The connection between female sexual disorders and some of the derangements of the general health hardly admits of any satisfactory explanation beyond their dependence on reflex action originating in utero-ovarian irritation. Long, however, before this doctrine was applied to these complaints, their existence in connection with uterine and ovarian disorders was well-recognised, and was ascribed by old writers to what they termed the *consensus nervorum*, or sympathy, by which, as Prochaska says, 'the operation of a stimulus is not limited to the nerves immediately irritated, but is extended to distant parts in known or unknown connexion with the irritated nerves.'

The remarkable difference in the constitutional sympathies with sexual disorders in the opposite sexes, is accounted for by the comparatively subordinate character of the male reproductive organs. In the female, on the contrary, the utero-ovarian functions are connected with every vital action, from the evolution of puberty until the climacteric period, which terminates her distinctive sexual or reproductive life, is passed. Woman is therefore always liable, as Dr. Storer observes, 'to a host of diseases peculiar to her sex, to which we find neither homologue nor analogue in man.'

Ætiology.—First, with respect to the effect of the general health in the causation of sexual disorders in women, there can be no doubt that these are in many cases the result of some constitutional diathesis. Of the large number of patients suffering from chronic uterine disorders, such as endometritis, cervicitis, ulceration and areolar hyperplasia of the cervix, ovaritis, pelvic or ovarian abscesses, sterility, repeated miscarriages, and all the derangements of menstruation that have come under the writer's care, the majority were of well-marked strumous diathesis, or suffered from scrofulous disease of other parts. The most common of uterine diseases is cervicitis, and in it the scrofulous form of inflammation is generally evident. The inflammatory action in these cases is attended by a characteristic tendency to produce excoriations of the cervical mucous membrane, resulting in typical strumous ulcers, which are tedious beyond patience in their cure by the local applications generally relied on, but yield readily when these are conjoined with appropriate constitutional treatment.

Gout and rheumatism, neuralgia, and secondary syphilis, should also be recognised as amongst

the occasional constitutional causes of chronic uterine or peri-uterine disease. In all such cases the functions of the affected organs are deranged to a greater or less extent.

Results.—We turn next to consider the converse question—the effect of sexual disorders on the bodily health. In many instances the local symptoms of uterine and ovarian complaints attract so much attention, that the practitioner may neglect the constitutional conditions with which sexual disorders are connected. Thus derangements of the catamenial function are generally associated with the nervous complaints of women. Many forms of hysteria, and the morbid excitability and perversion of the natural feminine instincts, without any tangible delusion or perceptible affection of the intellectual powers, which are so frequently met with, are thus conjoined with amenorrhœa or dysmenorrhœa. The connexion between hysteria and uterine or ovarian disorders is too obvious to call for any notice here (*see* Hysteria; and Insanity, Varieties of). In the present article we shall briefly notice a few of the principal disorders which may thus originate in sexual disturbances.

*Epilepsy.*—Epilepsy in women is very often symptomatic of uterine or ovarian disorder, and is curable by the restoration of the suppressed functional discharge, or the allayment of the existing local irritation.

*Perversions of tastes and temper.*—The influence of the sexual system in the causation of nervous disorders is well illustrated by those strange alterations in tastes and dispositions, that irritable condition of mind, those unreasonable likings or aversions, irresistible longings and foolish fancies which, even in women naturally strong and well-minded, commonly accompany and are produced by pregnancy. Of a similar nature are the nervous excitability, waywardness of temper, physical and mental lassitude, and depression of spirits which have been generally noticed as constant attendants on the menstrual periods in many women. These are also of interest as demonstrating, despite any exceptional cases to the contrary, the futility of that hopeless contest with Nature's laws, in which those are now engaged who would have woman abandon her own high sphere, to become in every profession and in every avocation the rival, instead of the helpmate, of man.

*Erotomania and Nymphomania.*—In connection with this subject erotomania and nymphomania must be referred to. The former is but an undue exaltation of that sentimentality which to some extent is a natural characteristic of female youth, and which is fostered into morbid development by ill-directed education, and the prevailing sensuous tone of much of our popular literature. Highly-coloured amatory word-pictures fill the minds of the young, unfit them for the duties of life, and give rise to those predominant illusions which morbidly occupy the thoughts of the erotomaniac, and may ultimately pass into the grosser pruriency of nymphomania. Whether originating in this way or not, nymphomania, when developed, is an entirely distinct disorder from the last-named complaint, and is generally connected with physical irritation or disease of some part of the sexual organs. Frequently it is associated with subacute endometritis or ovaritis, resulting in irritation and congestion of the erectile structure of the internal, as well as of the external, generative organs. In these cases pruritus of the vulva generally exists; and the local hyperæsthetic condition is followed by structural disease in the affected parts, hypertrophy of the nymphæ and clitoris, vaginismus, and chronic follicular vulvitis.

The moral, hygienic, and medical treatment of these conditions is discussed in other articles in this work. Here it is only necessary to add, that in the treatment of no forms of disease is the exercise of the highest qualities of the physician more required than in the management of erotomania and nymphomania. In these cases he must act on the religious and moral as well as on the physical constitution of his patients; he must seek to turn the perverted current of thought into better channels; insist on healthy occupation of mind and body; and clearly point out the physical ill-health and mental debasement which surely await on sexual abuses. At the same time the judicious practitioner will endeavour to strengthen the physical powers by tonics; to diminish general plethora by saline purgatives, to remove local congestions by appropriate treatment; and to lessen nervous irritability by the bromides and other nerve-sedatives. Generally such patients are idle and over-fed, and require work and abstinence, and in addressing these persons their medical attendant may well re-echo the advice given to Falstaff by his quondam friend Prince Hal, and desire them to 'Purge, foreswear sack, and live cleanly.'

With regard to local treatment in cases of nymphomania, all that need be said is that, vaginal examinations, being likely to increase the irritability of the hyperæsthetic parts, should, as a general rule, be altogether avoided; or, at least, should be resorted to only in exceptional instances, and when absolutely indispensable. At the same time, however, it is obvious that where nymphomania is the result of local disease, neither moral nor general medical treatment can be of use until the topical exciting cause is removed. It may be admitted that, in certain exceptional cases and with suitable restrictions, clitoridectomy is a useful procedure.

*Insanity.*—The effect of sexual disorders on the mental functions can be only very briefly alluded to. The fact is certain that insanity in women is frequently connected with functional derangement or organic disease of some portion of the utero-genital organs. Indeed in both sexes, although less obviously in men, reflex irritation from the sexual system has, probably, much to do with the causation of insanity. In the insane there is usually a peculiar insensibility to the ordinary symptoms of disease, resulting from the impaired nutrition and lowered vitality of the nervous centres and nerves of sensation. Therefore, in such cases, in the absence of the usual evidences of sexual disorders, the existence of these diseases is very likely to be overlooked. During the last few years several instances of mental derangement, of hysteria approximating to insanity, and of other forms of

nervous disturbance arising from ovarian causes, have come within the writer's observation. In some of these cases the nervous disorder had existed for a considerable time before its local exciting cause was suspected. And, more than once, the writer has seen this ultimate recognition and treatment of obscure uterine or ovarian disease in a woman, who had been for years in a lunatic asylum, followed by the restoration of mental as well as physical health.

The ordinary occurrence of menstrual irregularities, and especially of amenorrhœa, in the early periods of insanity, is recognised by nearly all writers on this subject; and there seems a general concurrence of opinion as to the direct connection between suppression of the menses and mental derangement in many instances. One of the most remarkable cases of this kind is that of a girl, mentioned by Pinel, who 'from the age of ten years was in a state of incoherence from suppression of the catamenia. One day on rising from bed she ran and embraced her mother, exclaiming, "Mamma! I am well." The catamenia had just flowed spontaneously, and her reason was immediately restored.'

*Puerperal mania.*—Puerperal mania is another instance of the influence of uterine or peri-uterine causes in disturbing the nervous system. The ætiology of this disease is very complicated, and it must be ascribed to the combined operation of several distinct factors. Foremost amongst these is the local condition of the denuded uterus during involution; and the shock and exhaustion consequent on parturition under conditions of mental depression, as shown by the fact that twelve out of twenty cases that came under the writer's notice occurred amongst unmarried patients in the Lying-in Hospital. Any circumstances that occasion suppression of the lochia or of the mammary secretion at this time, when the nervous system is in a state of peculiar tension, and the physical powers lowered, act directly as exciting causes of puerperal mania.

*Alcoholism.*— Uterine and ovarian disorders must also be reckoned amongst the predisposing causes of intemperance. The craving for alcohol in women of all classes, may frequently be dated from the first painful menstrual period, when stimulants are often forced by foolish mothers into reluctant lips. The pain of dysmenorrhœa being thus relieved, at the next epoch the girl naturally, and no longer unwillingly, seeks similar solace, until, finally, the victim of dysmenorrhœal alcoholism becomes a habitual, and perhaps an incurable, drunkard.

*Cardiac disorder.*—Of the cases of supposed heart-disease in nervous women, which daily come before those connected with any large hospital, in the greater number of instances the cardiac complaints are the result of hysteria, originating from chronic uterine or ovarian disorder, on the cure of which all the cardiac symptoms will subside. It is needless to dwell further here on the functional irregularities—palpitation, dyspnœa, and other symptoms of the same kind—which are thus connected with overstimulation and irritation, or disease, of the female sexual system.

*General health.*—The consequences of premature or excessive indulgence and abuse of the sexual appetites on the general health, claim merely a passing notice in this article. At no former time was it so necessary as at present for medical practitioners to recognise the evidences of these abuses and excesses; to which are due a large and increasing proportion of the disorders, mental and physical, by which human life is embittered or its duration shortened. The pathological results of these abuses, acting through and upon the nervous system, and the long train of maladies thus occasioned, must be familiar to every experienced physician who encounters in his practice the cachectic and debilitated victims of the excesses referred to. To these causes must be mainly ascribed the failure of physical stamina, the hyperæsthetic nervous condition, and the want of mental power and determination, noticeable amongst too many of the youth of the present day. Thus the evils resulting from this wide-spread sensuality, the effects of which are now seen in our hospitals and lunatic asylums, have attained such proportions as to be a subject of national as well as medical importance.

With respect to the constitutional relations of chronic disorders of the female sexual organs, Dr. Barnes very truly observes 'that disorder of the sexual organs cannot long continue without entailing constitutional disorder, or injuriously affecting the condition of other organs.' The most common of the chronic complaints peculiar to women are subacute endometritis and cervicitis. Next in frequency are the functional disorders occasioned by ovarian congestion and irritation. And, thirdly, in this connection are the various displacements and flexions of the uterus. The two first of these in all cases react on the general health. And even in the third, where local symptoms and local treatment obviously claim most consideration, the secondary consequences of the uterine dislocation often require attention, after the displacement or flexion has been mechanically remedied.

THOMAS MORE MADDEN.

**SEXUAL FUNCTIONS IN THE MALE, Disorders of.**—Disturbances of the most important sexual functions in the male are described under the following headings, to which the reader is referred:—IMPOTENCE; MASTURBATION; SPERMATORRHŒA; STERILITY IN THE MALE; and TESTES, Diseases of.

**SEXUAL ORGANS, Diseases of.**—The diseases of the several sexual organs in the male and female will be found described under their special headings. *See* PENIS, Diseases of; TESTES, Diseases of; OVARIES, Diseases of; VAGINA, Diseases of; WOMB, Diseases of; &c.

**SHAKING PALSY.** — A synonym for paralysis agitans. *See* PARALYSIS AGITANS.

**SHAMPOOING.**—SYNON.: Massage; Kneading; Medical rubbing; Fr. *Massage*; Ger. *Massiren.*

DEFINITION.—A process of treatment by rubbing, which consists in deep manipulation.

APPLICATIONS.— The shampooer grasps the part, and by squeezing it laterally in the palms of his hands in a peculiar manner, in which the muscles of the thumb are brought into vigorous

use, exerts a compressing force upon the deep muscular structures by a kind of kneading process. Muscular contractility is thus stimulated, and the circulation increased, so as to produce a corresponding increase of temperature.

By frequently repeating this process, the nutrition of the limbs operated upon is increased, and the flesh becomes much firmer, with a corresponding increase in muscular power. In India, where shampooing appears to have been an ancient practice, it is employed to restore enfeebled and debilitated muscles, exhausted by the heat of the climate. In England shampooing has of late years been much more generally used, and since the introduction of the Turkish baths, where trained shampooers are always in attendance, it can be more readily obtained.

Uses.—In infantile paralysis, if the limbs affected are shampooed for half-an-hour twice a day by a competent nurse, in addition to the use of galvanism and of warm clothing, the process of recovery—to which there is always a natural tendency—will be materially facilitated. In the more severe forms of paralysis, in the adult, less benefit can be expected from shampooing, though the warmth and circulation in paralysed limbs are improved by its use. In limbs weakened by the long-continued use of mechanical supports for any surgical purpose, shampooing is found to be of great service in improving the muscular strength, and restoring a healthy and vigorous circulation.

As employed by Dr. Weir Mitchell, and described by Dr. Playfair (*Lancet*, 1881, I. p. 857, and II. p. 991), shampooing appears to be of great value also in the systematic treatment of nervous prostration and hysteria.

William Adams.

**SHINGLES** (*cingulum*, a girdle).—A popular name for herpes zoster. *See* Herpes; and Zoster.

**SHIVERING.** *See* Rigor.

**SHOCK.**—Synon.: Fr. *Choc*; Ger. *Shok*; *Wundstupor*; *Wundschreck*.

Definition.—A condition of sudden depression of the whole of the functions of the body, due to powerful impressions upon the system by physical injury or mental emotion. Its more obvious manifestations are signs of lowered activity of the cardiac, respiratory, and sensorial functions; and reduction of the surface temperature.

General Description.—If a person be unexpectedly subjected to the influence of extreme terror, if a large bone or joint be shattered, or an important viscus injured, the entire system receives a profound impression, and its functional activity is more or less stunned. The whole body appears to sympathise with the injury inflicted on one of its parts; the patient is prostrated by an indescribable sense of bodily anguish and oppression; he feels sick and faint; is seized with tremor; totters or falls; the surface becomes pale, cold, and covered with sweat; the expression of countenance is vacant, yet anxious; and the respiration and circulation are weak and irregular.

Shock varies in degree, from the most trifling amount, which rapidly disappears, to that producing instantaneous death, as in the case of lightning stroke, or of a severe blow on the epigastrium.

The intensity of shock depends on the nature and extent of the injury producing it; on the coexistence of internal or external hæmorrhage; and also upon the age, habits, temperament, and idiosyncrasy of the individual, and his mental condition at the time of the injury. Direct violence applied to the brain or spinal cord produces shock in the most intense form, but in such cases, which are beyond the scope of this article, the symptoms due to the local lesion predominate, and are of course the more important.

Shock is usually immediate in its effects, but sometimes these may be for a time deferred by intense mental preoccupation or excitement. 'Nature,' as Hunter said, 'does not feel the injury.' The soldier during the excitement of battle may be unconscious for a time of the severity of his wound, but presently he is recalled to a sense of danger, and the depression which ensues will be increased in proportion to the previous excitement.

Ætiology.—Intense mental impressions, such as extreme terror, or apprehension of death or mutilation, are capable of producing shock in persons of excitable nervous temperament. Some individuals are so readily affected, that a certain degree of shock may be induced by the most trifling lesion, or even by the sight of an injury inflicted upon another.

It may be stated generally, however, that whatever is calculated to produce psychical depression, will aggravate the shock induced by other causes. Wounds, for instance, inflicted on the soldiers of a beaten army, or on those in a closely besieged town, are often followed by greater shock than are wounds of a similar severity occurring under different circumstances.

Injury is the chief cause of shock. As a rule the more extensive the injury, the nearer it is to the centre, and the more it assumes a crushing character, the greater will prove the amount of shock. The crushing of a finger or bruising of a testicle often occasions severe shock; so also do extensive burns and scalds. Intense pain, without serious organic lesion, is capable of producing shock, as may be witnessed during the passage of a gall-stone through the duct, or of a calculus through the ureter.

Loss of blood associated with the injury greatly augments the degree of shock; and it may be impossible to separate the symptoms due to the more direct physical impression from those caused by the hæmorrhage. Shock is, however, independent of the presence both of pain and of hæmorrhage. During the operation of castration a patient, while under the influence of chloroform, and in the absence of hæmorrhage, may present all the symptoms of profound shock, the moment the cord is divided. After disarticulation at the hip or shoulder joints, and in other great operations, the patient may present features of shock, altogether independently of either pain or loss of blood. Ovariotomy, especially the opening of the abdomen, is said to be occasionally attended by shock; but it does not occur after ovariotomy, except when the operation is severe and protracted, or associated with hæmorrhage.

The frequency of shock after operation has diminished since the introduction of anæsthetics, but chloroform itself may occasion some of its symptoms; and it is by no means unlikely that fatal accidents during chloroform-administration may be due to the combined depressing influences of the shock and the anæsthetic.

Injuries extensively involving the bones and joints are prone to induce shock. The temperature has been observed in some instances to fall during the sawing of the bone in amputation.

Railway accidents, happening as they do very suddenly, and occasioning great alarm; acute peritonitis caused by the escape of irritating substances into the abdominal cavity, as in perforation in typhoid fever; the strangulation of a hernia; or a sudden and severe intussusception, may each and all be attended by symptoms of shock in a more or less intense degree.

Pathology.—It is still difficult to explain the *modus operandi* by which any kind of physical injury, of sufficient severity, implicating any portion of the body, may produce the set of phenomena known as shock. The story told by the symptoms is one of depression of the whole vital functions, associated with all the evidences of a diminished circulation of blood in those portions of the periphery which we can examine during life. The integument is blanched and shrunken; the pulse is thready or imperceptible; the veins are collapsed; and open wounds, unless involving large arterial trunks, bleed slightly or cease to bleed; while the lowered temperature, as registered in the axilla and mouth, marks a coincident diminution of tissue-metamorphosis. That the brain suffers from a similar privation of blood is indicated by the enfeebled pulsation of the carotid arteries; by the anæmic condition of the retinal vessels, as shown by the ophthalmoscope; and by the mental torpor and feeble irritability, conjoined or separate, which constitute invariable features of the condition. How far the change is shared by other organs it is at present impossible to say, but, awaiting further investigations, the facts already known are sufficiently definite and constant to guide us in the direction of a rational pathology.

The manifestations of inadequate blood-supply to the tissues in general are almost identical with those of hæmorrhagic asthenia; but no hæmorrhage has taken place, and we must seek the blood which has left the anæmic parts in some other vascular territories.

If we make a *post-mortem* examination in a case where death has forestalled nature's effort at reaction, one striking phenomenon is revealed, namely, an enormous distension of the abdominal vessels governed by the splanchnics. Into this capacious set of vessels has been diverted a great mass of the blood destined for other regions; and being thus practically withdrawn from the general circulation, it has produced a useless congestion of the abdominal viscera, at the expense of the nutrition of the rest of the system, while the weakened heart contracts feebly but hastily upon the scanty supply which now passes through its cavities.

Physiologists have taught us the probable cause of this. Long since it was demonstrated that stimulation of the central end of the divided depressor branch of the vagus, in the rabbit, produces an immediate lowering of the blood-pressure in the arteries of the head, neck, and extremities; this effect coinciding with, and depending upon, a dilatation of the abdominal arteries, and a consequent derivation of the blood-flow in the direction of least resistance, or towards the abdominal viscera. If, however, the splanchnic nerves be cut, the reflex circuit is broken, and the balance of the circulation becomes restored, or nearly so, although the irritation of the depressor nerve be continued. The experiment of Goltz, of directly paralysing the splanchnic of a frog by sharply striking the abdomen, was followed by the same result as is the reflex paralysis of the same branches through the depressor nerve; and it is likely that the severe shock caused in man by a severe blow on the epigastrium, owes its origin to a similarly induced paralytic dilatation of the visceral arteries. For the present we may thus accept, as the most plausible interpretation of the symptoms of shock, a sudden dilatation of the abdominal vessels, attributable to an inhibitory influence exerted upon the splanchnics, through the medium of a special reflex centre, which is in more or less direct communication with the sensorium, and with all parts of the body. Much, however, remains to be done. It has been shown that when a rabbit is narcotized by chloral, stimulation of the central end of the divided sciatic nerve will induce a lowering of arterial pressure, corresponding closely to that initiated by stimulation of the depressor branch; and in all probability a similar experiment upon any nerve containing afferent fibres would be followed by the same result. But if, on the other hand, the same stimulation be performed while the animal is paralysed by curare, it is remarkable that the effect is reversed, the vessels controlled by the splanchnics contracting, and the general arterial tension being consequently increased. These observations are in the highest degree suggestive, and may hereafter form the basis for a plan of treatment of shock, that will be a landmark in surgical therapeutics.

Symptoms.—The symptoms of shock are of two kinds—namely, first, those due to a stunning or blunting of the vital powers, aptly styled *Wundstupor* by the Germans; and secondly, those attributable to mental terror, anxiety, and agitation—*Wundschreck*. These may exist together, or separately, or one may pass into the other.

1. *Pure* or *torpid shock*, as distinguished from the latter form, which may be termed 'erethitic shock,' is manifested, if only slight in degree, by transient symptoms. The patient becomes pale and faint; complains of nausea; trembles; and experiences a sense of oppression, confusion, and anxiety; the surface becomes cold and moist; beads of sweat form on the brow; and the limbs may be unable to support the weight of the body. The duration depends much on constitutional peculiarity; the symptoms either passing off in a few minutes, or lasting for an hour or two. If the shock be severe, the patient immediately after the receipt of the injury is stunned; his senses and consciousness are benumbed; the countenance and the surface generally become deadly pale, and are bathed with sweat; the animation

of the face is replaced by a mingled expression of torpor and anxiety; from time to time muscular contractions and uneasy movements of the body may occur, but usually there is an absence of voluntary effort; the eyes are dull, vacant, and motionless, and the pupils are usually dilated; the temperature—an important index to the severity of the shock—ranges from one to two degrees or more below the normal, and is much lower when there has been severe loss of blood; the respiration is remarkably slow and irregular—faint, scarcely perceptible, inspirations alternating with deep sighs; and the pulse may be almost or quite imperceptible at the wrist, very weak, insufficient, and very rapid. The patient is conscious, but he sees and acts as through a mist, and cannot realise his position; urgently questioned, he replies slowly and with evident effort; his voice is weak and hoarse; he may complain of coldness and numbness of his limbs, but appears scarcely sensible of pain. There may be nausea, and even vomiting; and relaxation of the sphincters, with involuntary discharge of fæces, is occasionally observed.

The fall of temperature in shock, excluding cases of injury to the brain and spinal cord—where it is greatest of all—is proportionately greater, other things being alike, in injuries extensively involving bones and joints, in burns and scalds, and in the cases where there has been considerable loss of blood. It is greater in amount in men of forty than in those of twenty. During the War of the Commune a number of observations were taken, and the average temperature varied from 96·5 to 97·5°, the lowest temperature observed being 93·5°. The fall was greater after shell- than bullet-wounds; and amongst the insurgents than in the regular troops.

2. In the *shock with excitement—restless* or *erethitic shock*—symptoms of anxiety and restlessness predominate. This form is often witnessed in association with previous hæmorrhage, or when there is great pain, as in crushing injuries of important parts, and in burns or scalds. Individual idiosyncrasy, however, has an important influence upon the condition. The ordinary symptoms of shock, such as pallor, cold surface, frequent pulse, and feeble respiration are present. The patient in addition betrays a marked and unceasing restlessness, tossing about in bed, and throwing his arms and head from side to side; his consciousness is but little impaired, yet he pays no heed to questions; nothing seems to comfort or quiet him; he appears as if overwhelmed by some indescribable anxiety and oppression, of which he vainly struggles to rid himself. Vomiting and painful eructations are usually present in such cases. There is often considerable tremor, and sometimes the case will pass into well-marked delirium tremens. The torpid may pass into the erethitic form of shock; or shock with excitement may lapse into a torpid condition, which is always a change of bad omen.

Duration.—Shock, unless it be the result of serious or fatal injury, is generally recovered from speedily and completely. It may be quite gone in fifteen minutes or half an hour; or it may continue five or six hours, or longer, and then pass away. The erethitic or restless form of shock does not continue so long as the torpid. The less important the vital lesion; the less it has been complicated with loss of blood; the greater the power of the individual; the less his nervous susceptibility; and, finally, the more efficient the treatment, the shorter will prove the duration of the shock.

Terminations.—Recovery or reaction takes place readily from the milder forms of shock, especially when aided by suitable treatment. From the more severe, it is more difficult and protracted; or the case may end more or less rapidly in fatal collapse. When the reaction proceeds favourably, the pulse becomes stronger and fuller, the respiration deeper, and the bodily warmth returns. The mind appears to awaken to the exercise of its faculties, to shake off its oppression, and to appreciate the nature of the previous injury, and of the existing circumstances; and both the mental and physical equilibrium are by degrees restored. Vomiting is often an early symptom of recovery.

The reaction is not always steady. Fluctuations may occur; and relapses after an improvement often occur once or twice, each time, however, with diminished severity.

When the torpid form of shock passes into the erethitic, the condition becomes one termed 'prostration with excitement'; the respiration is hurried, the skin hot, and the face flushed. There are great thirst, headache, and scanty urine, with restlessness, tremor, incoherence or delirium, and sleeplessness; and death from exhaustion frequently follows, preceded by a haggard, wild expression of face, a pulse that cannot be counted, subsultus, and hiccough.

After severe shock symptoms of excessive reaction are not uncommon; and their gravity will vary with the intensity of the previous shock.

Complications and Sequelæ.—The complications which may arise are those due chiefly to loss of blood, or peculiar to the form of injury received. From ordinary uncomplicated shock recovery is usually perfect, but occasionally, especially after railway shock, permanent deterioration of health follows, or some impairment of a special sense; or the mental vigour or temper of the individual may be changed for the worse. In these cases organic changes in the nerve-centres have probably supervened. In drunkards the shock of injury very often terminates in ordinary delirium tremens.

Pre-existing organic disease, especially of the heart or kidneys, renders persons more susceptible of the effects of shock, and shock more dangerous and severe.

Diagnosis.—The phenomena of shock bear some resemblance to those of concussion and of syncope. Concussion is usually distinguished from shock by the predominance of intellectual disturbance over the circulatory symptoms; and syncope is in most cases marked by its more transitory duration, and by its origin in loss of blood, or in other of the well-known causes of the condition. Shock, however, may co-exist with either concussion or syncope.

Prognosis.—This mainly depends on the nature of the injury, and the physical and mental power of the individual. Otherwise, the longer the shock endures, the feebler the manifestations

of life, and more especially the lower the temperature falls, the more unfavourable becomes the prognosis. A fall of temperature below 96° nearly always presages a fatal issue. It is a very unfavourable sign when no rise of temperature takes place in four or eight hours after the receipt of injury. Extreme feebleness of pulse and respiration, marked tremor, profuse cold sweat, singultus, a feeling of impending dissolution, and involuntary evacuations, all indicate gravity of the case.

Treatment. — The objects of treatment in shock are to sustain the lessened vitality, but not to over-stimulate it; and to moderate subsequent reaction when it is excessive.

To apply external warmth is the first and plainest indication, as it is one of the best appeals to the misdirected circulation. Hot water bottles and hot blankets may be applied to the extremities; hot turpentine epithems and sinapisms to the precordia; and turpentine may be rubbed along the spine with advantage. If the patient cannot swallow, an alcoholic stimulant may be injected into the rectum; and ammonia may be inhaled, or subcutaneously injected. Slapping the hands and feet promotes recovery in some cases, but this measure is inefficacious in cases of severe injury, or those accompanied by great loss of blood.

In profound shock, unaccompanied by loss of blood, the breathing must be carefully watched, and failure guarded against by artificial respiration. The phrenic nerve may be usefully stimulated by electrodes placed along its course in the neck, and in the epigastrium. If the external jugular vein be gorged with blood, it may prove advantageous to open it, and thus relieve the stagnation of the venous circulation. Where shock has been accompanied by severe hæmorrhage, transfusion in extreme cases should be resorted to. As soon as practicable, nourishment must be administered, as well as stimulants. Tincture of belladonna has been given in half-drachm doses every hour in some cases, with the view of stimulating the cardiac action, and helping to contract the paralysed arterioles. The use of calabar bean has been recommended, on account of its power to diminish the venous accumulation in the abdomen, by causing contraction of the veins.

If shock be associated with excitement, which should be regarded as a sign of want of power, the patient always requires support; and opium, or, when this drug is not desirable, henbane or chloral, may often be given with advantage. An ice-coil to the head allays excitement and promotes sleep. In the torpid form of shock narcotics are inadmissible. Should inflammatory reaction take place, a regulated diet, rest to mind and body, a gentle mercurial purge, when the secretions are deranged, and in young plethoric subjects the cautious administration of antimony, or a local blood-letting, are the chief means to be adopted. Throughout the treatment caution should always be exercised not to strain the action of remedies too far.

The question of operation in shock may occasionally be difficult to solve. As a rule a patient suffering from severe shock should never be operated upon; unless, indeed, bleeding be going on, or the arteries and nerves are much exposed and lacerated from the violence of the injury. When an operation appears to be compulsory no anæsthetic is required. It is better, however, to await partial reaction whenever it is possible to do so.

William Mac Cormac.

**SHORTNESS OF BREATH.** *See* Respiration, Disorders of.

**SHORT-SIGHTEDNESS.** *See* Myopia; and Vision, Disorders of.

**SIALAGOGUES** (σίαλον, saliva, and ἄγω, I move).—Synon: Fr. *Sialagogues*; Ger. *Speicheltreibende Mitteln.*

Definition.—Remedies which increase the secretion of saliva.

Enumeration.—The principal sialagogues are Dilute Acids, Ether, Ginger, Rhubarb, Horseradish, Iodide of Potassium and other iodides, Jaborandi, Mezereon, Mercury and its salts, Mustard, Tobacco, Physostigma, Pyrethrum, and Pebbles.

Action.—There are two essential factors in the secretion of saliva; the first is the activity of the secreting cells in the gland, the second is a sufficient supply of nutritive material to them, from which they may form a secretion. This nutritive material, though it may be derived directly from the lymph-spaces around the cells, must be ultimately supplied by the blood circulating through the glands. Usually, therefore, when the gland is in action, the supply of blood is greatly increased, the arteries dilating, and the blood flowing rapidly through them. Some drugs, such as physostigma, will stimulate the secreting cells, while they contract the blood-vessels; and under these circumstances, although the secretion may begin actively, it soon comes to a standstill from want of material. The secreting cells may be excited to activity, by substances which stimulate the nervous structures within the gland itself, as, for example, calabar bean (physostigma); by stimuli proceeding directly from the encephalon, as seen in salivation occurring from the mere idea of savoury food; and by stimuli applied to the mouth and exciting the gland reflexly. Nausea is almost always accompanied by salivation, and substances which cause nausea almost invariably cause salivation, the irritation of the stomach causing reflex salivary secretion. The stimulus here passes up the afferent nerves to the medulla, and travels down the efferent nerve to the gland.

Sialagogues are divided, according to their mode of action, into two classes (1) *topical* or *direct*; and (2) *specific*, *remote*, or *indirect* sialagogues. The names *direct* and *indirect* are complete misnomers, just as they are in the case of emetics, and they ought to be discarded, inasmuch as the so-called 'direct' sialagogues are those which do *not* act directly on the gland, but on the mouth; and the 'indirect' are those which do act upon the gland, affecting either the nervous structure contained within it, or the nerve-centres directly connected with it.

The *topical* sialagogues are dilute acids, ether, ginger, rhubarb, horseradish, mezereon, mustard, pebbles, pyrethrum, and tobacco. The *remote*

sialagogues are iodide of potassium and other iodides, jaborandi, mercury and its salts, physostigma, and tobacco.

Topical sialagogues excite secretion of saliva reflexly, the afferent nerves being the lingual and buccal branches of the fifth, and the glossopharyngeal nerves. The afferent nerves, through which nauseants probably excite the salivary secretion, are the vagi.

Of remote sialagogues, iodide of potassium probably acts upon the gland-structures, but upon which part has not yet been determined. It may, however, also act reflexly, by stimulating the sensory nerves of the mouth, as it is excreted in the saliva, and the taste of it is often persistent. Mercury probably acts partly by affecting the gland-structures, and partly by affecting the mouth. Jaborandi, physostigma, and tobacco appear to affect the terminal branches of the secretory nerves in the glands.

Uses.—Saliva is useful in keeping the mouth moist, and thus facilitating mastication, deglutition, and the movements of the tongue in speaking. By moistening the fauces it also prevents or lessens thirst. A pebble placed under the tongue, or masticated, will keep up a slight flow of saliva, and may be useful for these purposes. Where this is insufficient, dilute acids are employed (*see* Acids). As the flow of blood to the glands is greatly increased through secretion, sialagogues have been used as derivatives, to lessen inflammation, congestion, and pain in other parts of the head, as in tooth-ache, ear-ache, and inflammation of the ear, nose, or scalp. Saliva has also, however, a digestive power upon starch, and increase of the flow may be advantageous in imperfect digestion of this substance. When swallowed, the saliva stimulates the secretion of gastric juice, and increased salivary secretion therefore tends to aid gastric digestion. To attain this object it is best to chew a piece of ginger or of rhubarb.

T. Lauder Brunton.

**SIBBENS.** — This term, derived from a Scotch word, signifying 'kindred,' is suggestive of a disease prevalent in families, and presumed to be a form of chronic syphilis.

**SIBILANT RÂLE, or RHONCHUS: SIBILUS** (*sibilus*, whistling).—A variety of dry *râle* or rhonchus, of a whistling or high-pitched musical character, usually produced in the smaller divisions of the bronchi. *See* Physical Examination; and Rhonchus.

**SICILY.**—A warm, moist, winter climate. Climate of base of Ætna more variable than N. coast. *See* Climate, Treatment of Disease by; and Palermo.

**SICK HEADACHE.**—A popular synonym for megrim. *See* Megrim.

**SICKNESS.**—A common name for vomiting. *See* Vomiting.

**SIGHT, Disorders of.** *See* Vision, Disorders of.

**SIGNS OF DISEASE.** *See* Disease, Symptoms and Signs of; and Physical Examination.

**SINGULTUS** (Lat. sobbing, hiccup).—A synonym for hiccup. *See* Hiccup.

**SINUS** (Lat.).—Pathologically, sinus means a narrow track of variable length, leading from a chronic abscess to a free surface. *See* Abscess.

**SINUSES CEREBRAL, Diseases of.** *See* Meninges, Diseases of.

**SINUSES, NASAL, Diseases of.** *See* Nose, Diseases of.

**SIXTH NERVE, Diseases of.**—The sixth nerve, or *abducens oculi*, confers motor power on the external rectus muscle of the eyeball, and its morbid states of excessive or defective function are indicated by corresponding spasm or paralysis of that muscle.

1. **Spasm of the external rectus.**—This condition is very rare, except as a consequence of some change in the visual functions of the eye. The external rectus may then habitually overact, causing divergent strabismus. Permanent contraction occurs when there is complete paralysis of its antagonist, the internal rectus. Spasm may occur from irritation of the nucleus or fibres of the sixth nerve, as in meningitis of the base. The symptoms are inclination outward of the affected eye, and consequent divergent strabismus. The treatment is that of the cause on which it depends. *See* Strabismus.

2. **Paralysis of the external rectus.**—Ætiology.—The common causes of this condition are cold, acting possibly on the nerve-fibres within the muscle, but more probably by giving rise to inflammation around the trunk of the nerve; syphilis, by causing growth on, or exudation round, the nerve, or meningeal thickening; meningitis; pressure on the nerve by aneurism or tumour; and organic diseases of the pons. Transient or permanent paralysis sometimes accompanies sclerosis of the posterior columns of the spinal cord (locomotor ataxy); its cause is obscure.

Symptoms.—Paralysis of the external rectus causes inability to move the affected eye outwards, and hence convergent strabismus, and homonymous diplopia when looking at an object on the affected (say left) side of the middle line, the images becoming more distant as the object is moved to the left, but parallel, and on the same level, so long as it is on the level of the eye. When looking up or down as well as out, the second image slants, the two being nearer together at the lower end, and the second image the lower of the two when looking up and out. On looking down and out, the two images are nearer together at the top than at the bottom, and the second image is on a higher level than the other. There is erroneous projection of the field of vision.

Diagnosis.—Paralysis of the sixth nerve is easily recognised, except when slight in degree. In the latter case it may often be detected by a careful search for the diplopia, or by the secondary deviation of the sound eye in the same direction when that eye is covered and an object fixed by means of the weak muscle. *See* Strabismus.

Prognosis.—The prognosis is most favourable when the paralysis is due to cold or syphilis; least

favourable when due to meningitis or tumour. When associated with ataxy, it is usually recovered from, but a return is common.

Treatment.—When the complaint is of rheumatic origin, the treatment should consist of hot fomentations to the temple; counter-irritation by blisters; and iodide of potassium and tonics internally. If of syphilitic origin iodide of mercury or of potassium should of course be given.

In spinal mischief, strychnia and arsenic are useful. In obstinate cases, faradization, or the interrupted battery current, may be applied to the muscle through the eyelid, or to the temple to produce a reflex effect. The direct application to the muscle through the conjunctiva is too painful. W. R. Gowers.

**SKIN, Diseases of.**—Synon.: Fr. *Maladies de la Peau*; Ger. *Hautkrankheiten.*

Definition.—Cutaneous diseases may be defined as an aberration of the skin from the standard of health, evidenced by an alteration in its appearance, qualities, sensibility, functions, and relations to the rest of the organism.

Classification.—The ancients classed diseases of the skin according to colour, roughness or smoothness, and bulk. At the present time we shall find no better classification for all practical purposes than —(1) diseases of the *circulation*; (2) of *nutrition*; and (3) of *sensibility*. This applies to the skin in general; but the compound nature of the skin—consisting as it does of a pigment-organ, the rete mucosum; a horny covering, the epidermis; an apparatus of sebiparous and sudoriparous glands; and a special outgrowth of the derma, the hair—requires an expansion of this classification, so as to include specially the diseases of these separate parts. Hence a very simple subdivision of diseases of the skin, founded on the anatomical structure of the organ, would be, besides diseases of the *skin in general*—(4) diseases of the *rete mucosum*; (5) diseases of the *epidermis*; (6) diseases of the *glandular apparatus*; and (7) diseases of the *hair-follicles and hair.*

1. *Diseases of the Circulation.*—Diseases of the cutaneous circulation are manifested by hyperæmia, and principally by inflammation; and inflammation, according to its origin from ordinary constitutional causes or from blood-poison, admits of a division into *common* inflammation and *specific* inflammation. Common inflammation is represented by eczema, erythema, pemphigus and anthrax; and specific inflammation by the exanthemata, syphilis, and elephantiasis. The four examples of diseases of common inflammation above mentioned may be taken as types of so many groups of cutaneous disease, for example, eczematous, erythematous, phlyctenous, and anthracoid. The eczematous group comprises eczema, scabies, lichen, and impetigo; the erythematous group, erythema and erysipelas; the phlyctenoid group, miliaria, pemphigus, and herpes; and the anthracoid group, ecthyma, hordeolum, furunculus, and anthrax. In like manner, treating specific inflammation according to the same method, we have an exanthematous group, composed of rubeola, scarlatina, and variola; a syphilous group presenting itself in the forms of erythema, papule, tubercle, ulcer, and gummated tumour; and an elephantous group, which includes the macular, tubercular, anæsthetic, and mutilating forms of elephantiasis.



2. *Diseases of Nutrition.*—Diseases of nutrition are consequent on aberration of nutritive function, sometimes in the form of dystrophy or altered nutrition, sometimes as atrophy or absence of nutrition, and sometimes as hypertrophy or excessive growth. Under the head of dystrophic affections are to be included—lepra or psoriasis, struma or scrofula, lupus, lymphoma, xanthoma, and epithelioma; under that of atrophic affections—dermatoxerasia, ichthyosis, sauriosis, striæ atrophicæ, morphœa, and scleriasis; and under the head of hypertrophic affections—spilus, verruca, cornu, clavus, angeioma, fibroma general and partial, and mycosis; general fibroma including spargosis or elephantiasis Arabum; and partial fibroma, molluscum, and cheloma.

3. *Diseases of Sensibility.*—Diseases of innervation comprehend pruritus, prurigo, dermatalgia, neuroma, which are examples of dysæsthesia; with hyperæsthesia and anæsthesia.

4. *Diseases of Pigmentation.*—Disease of the rete mucosum, the seat of the colour of the skin, constituting chromatopathia and a group of chromatopathic affections, has its principal seat in the rete mucosum, and is manifested by excess of pigment, termed melasma or melanopathia; deficiency of pigment, termed achroma or leucopathia; and aberrations from the normal standard of colour, as in xanthochroia or excess of yellow, and cyanopathia, or the presence of blue pigment in the skin. To this group must also be added the leaden or slate-coloured hue of the integument, produced by the chemical operation of nitrate of silver on the superficial portion of the corium, named melasma tinctum and argyria.

5. *Diseases of the Epidermis and Nails.*—Diseases of the epidermis and nails constitute an epidermic and onychopathic group of affections of the skin, the former of these being remarkable for the presence of a phytiform growth within its structure, as in tinea or ringworm, and favus—the so-called *nosophyta*; and the latter embracing all the varieties of disease of form, texture, colour, and bulk of the nails.

6. *Diseases of the Cutaneous Glands.*—Diseases of the glands of the skin and their functions constitute a group of steatopathic affections, and another of idrotopathic affections. Of these, the former includes steatorrhœa or excessive secretion, comedones or impacted secretion, molluscum contagiosum *seu* adenosum or hypertrophy of the sebiparous glands, encysted tumours resulting from dilatation of the follicles with sebaceous secretion, and sebaceous horns consequent on the desiccation of inspissated sebaceous matter, exuded through an aperture of the cyst. The idrotopathic affections comprehend excess, deficiency, and alteration of cutaneous perspiration, represented by the terms hyperidrosis, anidrosis, osmidrosis or fœtid perspiration, chromidrosis or coloured perspiration, hæmidrosis or sanguineous sweat, and inflammation of the sweat-glands.

7. *Diseases of the Hairs and Hair-follicles.*—Diseases of the hair-follicles and hair are re-

presented by affections of the hair-follicles proper, for example, folliculitis, acne, gutta rosacea, sycosis, and favus; and by special affections of the hair, comprehending alteration of quantity, colour, and structure.

Ætiology.—The ætiology of cutaneous diseases embraces most of the causes which give rise to disease of other organs of the body; the only special characteristic of the skin being its peripheral distribution, and its consequent exposure to friction and to the action of the atmosphere. Like other organs it is dependent for its health upon healthy nutrition and innervation. When nutrition is defective in infancy and youth, the skin loses its powers of resistance; it becomes abnormally sensitive to the action of irritants from within and from without; and it is consequently prone to eczema, lichen, struma, and acne. Hence derangements of digestion and cutting of teeth are common causes of eczema in infants; struma is often developed for the first time with the appearance of the permanent teeth; and acne accompanies the active development of the hair at and after puberty. Thus, in considering the ætiology of diseases of the skin, we may take as a starting-point a weak organ, whatever the causes of that weakness of organ may have been, and then endeavour to discover the agency of the exciting cause. A weakly parent may become the mother of an ill-nourished infant, or may be unable to supply it with congenial food; a weak and sensitive skin follows; and then a variety of excitants, operating on a skin so predisposed, may give rise to an eczema. Or, if in place of a weakly parent we assume a faulty digestive apparatus, the skin may equally be the sufferer, and then an accidental malassimilation will become an exciting cause of eczema, erythema, or urticaria. In like manner an external irritant, such as friction, may promote the development of an eczema. The cause may, however, be in itself so potent as to develop an exanthem in an otherwise healthy skin, as in the exanthematous fevers.

Disturbances of innervation may be associated with discolouration of the skin, as in Addison's disease; or with eruptions, such as herpes.

Next to malassimilation and specific poisons as causes of cutaneous disease, defective nutrition is evinced in ichthyosis, achroma, alopecia, and lupus erythematosus; and aberration of nutrition in struma, lupus, lepra vulgaris, and in the various forms of hypertrophy, general and partial.

Poisonous articles of food may produce skin-eruptions. Thus urticaria follows the use of certain kinds of fish, more especially mussels, or of other indigestible substances. Certain drugs, too, have a specific action on the skin, giving rise to various forms of rash; for example, the salts of iodine and bromine, cubebs, copaiba, and quinine. Borax has recently been said by Dr. Gowers to produce psoriasis (*Lancet*, 1881, vol. ii.).

As a summary of the ætiology of cutaneous diseases, they may be said to be the product of a feeble organ, induced by debility or derangement of constitution; and the therapeutical corollary will follow—restore power to the constitution, the organ will recover, and the disease will cease.

Symptoms.—The semeiology or symptomatology of cutaneous diseases is principally manifested by alteration of the **colour, texture,** and **sensibility** of the skin. Change of colour may proceed from abnormal circulation, giving rise to various tints of red, ranging from scarlet to livid; or from aberrations of pigment. Change of texture is evinced by abnormal hardness or softness, thickness or thinness, roughness or smoothness, swelling or prominence, or solution of continuity in the form of cracks or ulcers.

**Colour.**—(*a*) The brighter tints of redness proceed from active *hyperæmia*, while the duller, the purple, and the livid are the consequence of passive hyperæmia. The brightest of the hues of redness are met with in erythema, urticaria, eczema, and scarlatina; the tint of roseola, rubeola, and the syphilodermata trenches on the purple; while the hyperæmia resulting from venous congestion is livid and almost black, as we see evinced in *morbus cæruleus*, in chilblain, and in anthrax. Angeiectasia and nævi are scarlet, crimson, purple or livid, in correspondence with the activity of circulation through their blood-vessels; and effusions of blood into the cutaneous tissues, as in purpura and ecchymosis, range between crimson and black. It is essential to distinguish between a redness which is transient and one which is permanent; between that which may be regarded as a pathological blush, such as erythema and urticaria, that which indicates a superficial inflammation, as in the case of eczema and erysipelas, or a deeper inflammation, as in the instance of furunculus and anthrax; and in the case of permanent redness, a state of angeiectasia or a vascular nævus.

(*b*) Changes of colour from aberration of *pigmentation* are commonly restricted to the rete mucosum, and range in hue from the whiteness of achroma, through the yellow and brown stains of lentigo and chloasma, to the deepest black of melasma. Altered pigmentation is also met with in the tissue of the corium; as in the yellow tints of xanthoma, the black deposits of melasma, the chemical stain of oxide of silver, and the mechanical colouration of tattoo.

**Texture.**—Alterations of texture of the skin are discoverable by the touch as well as by the eye. Infiltration of the cutaneous tissues communicates to the hand a feeling of density and thickness; this may always be observed in eczema, where it gives rise to slight swelling, but is most conspicuous in erysipelas, and in the tumescent forms of erythema. Similar infiltration, together with hyperæmia and hypertrophy, produces the various forms of pimples, tubercles, and tumours of the substance of the skin. We must, however, except from this cause the tubercles of urticaria, which are consequent on muscular contractility; and those of chronic syphilis, elephantiasis, lupus, lymphadenoma, and epithelioma, which are due to the formation of a new tissue. In chronic eczema, in the lepra of the Greeks, and in diffused lichen planus, the skin is sometimes found as hard and dense as leather, from infiltration; and in this state it not infrequently cracks and breaks, so as to produce chaps or rhagades. The skin is apt to be roughened in chronic eczema by hypertrophy and exfoliation of the epidermis, and most conspicuously so in lepra vulgaris

while a state of congenital roughness of the skin is pathognomonic of xeroderma and ichthyosis. In alopecia universalis the skin is morbidly soft and smooth; and it is likewise smooth and thin, from defect of nutrition, in alopecia areata. The texture of the skin is also rendered abnormal by the prominence of the follicles of the skin in the form of papulæ, as in a cutis anserina resulting from vascular congestion and infiltration instead of from muscular spasm; by the production of vesicles and sero-pustules, the consequence of exudation; by surface exudation giving rise to crusts of various thickness—all of these states being common to eczema; by the hypertrophic laminæ of epidermis generated by the congested blotches of lepra vulgaris; and by the ulcers of lupus, syphilis, and elephantiasis. It is important, therefore, to discriminate between variation of texture due to alteration of the skin in its whole or in its parts. Thickness and condensation may proceed from infiltration solely, from infiltration with active hyperæmia, from infiltration with hypertrophy, or from the development of a new and abnormal tissue; it may be restricted to the derma proper, or it may spread to the subcutaneous tissues; or the alteration may be one involving separately the papillæ, the glands, or the fibrous or other tissues of the corium.

Sensibility.—Altered sensibility may present itself as an excess or defect of sensibility, itching, tingling, pricking, heat, chill, or actual pain.

Diagnosis.—The diagnosis of cutaneous diseases is governed primarily by the physiognomy of the affection, aided by corroborative evidence supplied by the history, constitution, age, duration, cause, regional distribution, symptoms, &c.; in a word, by all the information which pathology and experience have brought to bear on the subject.

Prognosis.—The prognosis of cutaneous diseases is in general favourable. They are vexatious to the patient, sometimes on account of their ugliness, at other times from the teasing itching, or even pain, by which they are accompanied; but they are rarely fatal. Indeed their gravity is regulated by their cause, and by the constitution of the patient, rather than by their own intrinsic qualities. The most universal of cutaneous diseases, eczema, originates in malassimilation; and its cure or persistency will depend on our powers of restoring assimilation to a healthy standard, and this again will be governed by the circumstances and position in life of the patient. Erythema, and especially urticaria, are due to a state of constitution, and in themselves are simply a symptom of constitutional disorder. Sufferers from pemphigus sometimes die, because pemphigus is often a symptom of asthenia and cachexia; and anthrax, which occasionally kills by pain alone, is, in general, only fatal from constitutional complication. In specific inflammation of the skin the prognosis turns upon the curability of the major disorder—of the rubeola, the scarlatina, the variola, the syphilis, or the elephantiasis; and these are all curable, saving accidental complications, except elephantiasis, which must be regarded as an incurable disease. In the dystrophic affections—the Greek lepra, struma, and epithelioma, medicine is placed at the mercy of a feeble constitution; and although we may do much to improve, we cannot profess to cure. The same may be said for the rest of the nutritive affections; we can cure some, such as ichthyosis, but we must fail signally in our attempts to cure others, because we possess no direct means of renovating a faulty constitution, or of giving strength and energy to a feeble organ, and thus restoring its normal function. The neuropathic affections, again, present to us the problem of cure of a disordered nervous system; if that disorder be simply functional or due to derangement of general health, we shall probably succeed; if the alteration in the nerve-tissue be organic, we must necessarily fail.

Treatment.—The treatment of cutaneous diseases divides itself naturally into constitutional and local. Sometimes the constitutional treatment is alone essential, as in non-ulcerative syphilis; at other times local treatment only is required, as in the chronic forms of eczema, termed psoriasis by Willan and Bateman; but in general a judicious combination of the two is necessary. The aim of therapeutical treatment should be to restore healthy function and normal vital power; and the recovery of these will frequently prove sufficient to accomplish the cure of the local affection, if the latter have been shielded in the meantime by soothing applications. Mild tonic aperients, succeeded by tonics, especially by quinine, iron, and arsenic, constitute the special treatment of the whole family of inflammatory affections of the skin. Where the restoration of the nutritive power of the skin is a primary indication, as in non-inflammatory lepra vulgaris, and in every instance in which the nutrition of the skin is to be amended, arsenic may be regarded as a specific remedy.

The local remedies for cutaneous diseases are alleviative, stimulant, and caustic. Alleviative remedies, such as the oxide of zinc ointment, are especially adapted to the inflammatory affections, headed by eczema; chronic eczema and lepra vulgaris or psoriasis require the stimulating help of the mercurial ointments and tar; while lupus and epithelioma necessitate the employment of caustics, such as nitrate of silver and potassa fusa. Besides these, which are the essential remedies, there are others adapted for special purposes, which are mentioned in connection with the different diseases to which they are applicable. They consist principally of absorbent powders and lotions; lotions to relieve pruritus; and sulphur applications for scabies.

The several diseases of the skin are fully discussed under their respective headings.

Erasmus Wilson.

**SKIN, BRONZED.**—A form of pigmentary discolouration of the skin, embodying a reddish tint, in lieu of the yellow and green hues which are met with in lentigo and chloasma, and the absolute black of melasma. When the complexion is darkened by the action of the atmosphere and of the sun, it is said to be bronzed; and the term 'bronzed skin' has become familiar also in consequence of its application to the melasma of the skin in Addison's disease. Bronzed skin, again, calls to mind the copper colour of chronic syphiloderma, in which the melasma is

modified by red and yellow. In alliance with Addison's disease, melasma must not be regarded as specific, but simply as the ordinary melasmic change of colour of the disordered skin, of which the 'bronze' tint is an accidental modification. *See* ADDISON'S DISEASE; and PIGMENTARY SKIN-DISEASES. ERASMUS WILSON.

**SKIN, DISCOLOURED.** *See* PIGMENTARY SKIN-DISEASES.

**SKIN-BOUND DISEASE.**—A popular synonym for Sclerema neonatorum. *See* SCLEREMA NEONATORUM.

**SKODAIC RESONANCE.**— A peculiar high-pitched resonance, found chiefly at the sterno-clavicular region of the chest, in some cases of pleural effusion. *See* PHYSICAL EXAMINATION.

**SKOLIOSIS** (σκολιὸς, crooked).—A synonym for curvature of the spine. *See* SPINE, Diseases and Curvatures of.

**SKULL, Diseases and Deformities of.**—SYNON.: Fr. *Maladies du Crâne*; Ger. *Krankheiten des Schädels.*—The principal diseases and deformities of the skull will be discussed in the following order:—1. Changes of shape; 2. Variations in size; 3. Meningocele and Hernia Cerebri; 4. Cephalhæmatoma; 5. Inflammation; 6. Rickets; 7. Craniotabes; 8. Syphilis; and 9. Tumours.

**1. Changes of shape.**–The shape of the skull not only varies much amongst the different races of mankind, but in each race variations are to be found, sometimes depending upon, sometimes independent of, disease in the individual. A glance at any extensive collection of crania is sufficient to indicate how much larger some skulls are than others, in proportion to their width; how in some the vertical diameter is proportionally great, in others small; how some have wide cheekbones, some depressed noses, and others projecting jaws. The old classification of Blumenbach has now been superseded by the numerous and minute observations of recent investigators. For a short account of the methods of craniometry now in use, and of the present transitional state of the science, the reader is referred to the ninth edition of Dr. Jones Quain's *Anatomy*, vol. i. p. 80, where he will also find references to most of the important works upon the subject.

The skull is seldom perfectly symmetrical; the asymmetry being usually more marked behind than in front. This is shown not only by a coarse examination of the exterior, but by referring to the differences between the sulci and foramina on the two sides, which are so commonly met with. A familiar illustration is afforded by the fact that the nose is rarely if ever exactly in the mid line of the body; but much more striking deviations from perfect symmetry may occur, as, for instance, in a case recently reported by Mr. Pearce Gould to the Pathological Society, in which one half of the cerebellum was absent, and there was a corresponding deficiency of the cerebellar fossa on the occipital bone. Many savage races produce abnormalities of the shape of the skull, by the application of external pressure during early infancy; and a similar result has been supposed to be consequent on the method of wrapping up the heads of children that is adopted in some parts of France. A marked asymmetry of the skull accompanies that rare disease, 'hemiatrophy of the face,' supposed by Mr. Hutchinson to be related in some way to morphœa. There are also recorded cases of hypertrophy of the bones of the face and skull. A remarkable instance of this disease, or rather of the development of enormous hyperostoses, was shown by Mr. Hutchinson, in his recent lectures on Surgical Affections of the Nervous System, at the Royal College of Surgeons. Here the hyperostoses appeared closely confined to parts which were supplied by branches of the fifth nerve. Some of these hypertrophic cases are, no doubt, examples of exostosis, others of inflammatory enlargement. An uniformly thickened skull, depending presumably, though not certainly, on the latter cause, may be either porous like cancellous bone, or dense and heavy like ivory. There is in the museum of the College of Surgeons an example of both varieties, each of which measures in many parts no less than $\frac{7}{8}$ in. in thickness; in the porous variety the sutures are usually more or less completely ossified. The writer has seen a case in which, without apparent cause, the growth of one half of the lower jaw appeared to be arrested about the age of puberty, which gave a peculiar inequality to the face. Remarkable deformity of the skull may result from the constrained position in which the head is held by patients suffering from torticollis.

**2. Variations in size.**–The size of the skull is also subject to considerable variations in different races. It is somewhat larger, on the average, in men than in women. Amongst individuals also there are very great differences. Great intellects have sometimes been associated with large crania, but oftener there has been no such relationship, and not unfrequently the opposite has been the case. Far greater, however, are the modifications of size, which depend upon pathological conditions and defects of development. Some of these are briefly as follows:—

*a. Microcephalic idiots.*—Amongst this class of idiots, which must be made to include the cretins, the skull is remarkably deficient in size. Microcephalic skulls may be caused by a too early union of the sutures, in which case the want of development of the brain may be looked upon as a result of this synostosis; or there may be a normal condition of the sutures as regards union, but both the brain and the skull remain undeveloped. The low forehead and animal face which are characteristic of this condition, give a remarkably unpleasing appearance to the child. The amount of idiocy depends upon the size and structure of the brain, and the development of the convolutions. *See* CRETINISM.

*b. Anencephalic monsters.*—This class exhibits a more or less complete deficiency in the development of the cranial bones, as well as of the brain. The great variety of abnormalities which may be met with will be found described in the article BRAIN, Malformations of.

*c. Hydrocephalic infants.*—These infants have skulls of a size proportionate to the amount of fluid which is present, and they may thus some-

times reach enormous dimensions. *See* HYDROCEPHALUS, Chronic.

In this connection must be mentioned that extremely rare disease in children—hypertrophy and sclerosis of the *brain*, which involves a corresponding increase in the size of the skull. *See* BRAIN, Hypertrophy of.

3. **Meningocele and Encephalocele.**—Closely related also to hydrocephalus are the cases of meningocele and encephalocele. It may briefly be stated here that they involve the existence of a deficiency at some point of the skull, through which the membranes of the brain, containing cerebro-spinal fluid, or indeed some part of the brain itself, may protrude. The most frequent seat of this disease is the occipital bone, and the next in frequency the nasal part of the frontal bone, but tumours of this nature have been met with in other situations. It is of the highest importance to diagnose these two kinds of tumour from those developed in the bones of the skull or outside them; mistakes in diagnosis have not unfrequently led to most disastrous results, as, for example, when a meningocele has simulated a polypus of the nose, and its removal has been undertaken. If patients who have suffered from meningocele or encephalocele recover—a most rare occurrence—a small hole may remain in the bone which presented the deficiency, or the opening may be completely obliterated.

4. **Cephalhæmatoma.**—True cephalhæmatoma is a collection of blood between the periosteum and the skull. It occurs congenitally, usually on the right parietal bone, but often on the left, and as a rule varies in size from an inch to two inches in diameter; and it is surrounded by a hard, well-defined margin, which ultimately is composed of bone. It is probably in most cases, if not in all, the result of mechanical violence during delivery. An exactly similar condition is often seen as the result of a contusion in later life. If left alone a cephalhæmatoma generally disappears. If suppuration have taken place incision becomes necessary. *See* CEPHALHÆMATOMA.

The term cephalhæmatoma might equally well be applied to collections of blood between the dura mater and the skull. Such effusions are probably always traumatic, and result from the rupture of a meningeal artery or vein. If serious results do not immediately follow from pressure on the brain, considerable thickening of the dura mater may be set up, accompanied by the symptoms known as those of pachymeningitis. *See* MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.

5. **Inflammatory Diseases.**

*a. Inflammation of the diploë and its veins.*—In cases of injury to the skull, whether of the nature of fracture or of simple exposure in a scalp-wound, inflammation of the diploic veins is not uncommon, if the wound be allowed to putrefy. Under such circumstances if the outer table be removed, the whole diploë and its veins are found to be filled with pus, or on applying a trephine to a bone thus affected, the pus may be seen to exude from the divided veins. The dura mater, under such circumstances, may be affected, or pus may collect between it and the bone. Pyæmia, with its characteristic concomitant symptoms, is the frequent, if not the invariable, result. It is not assumed that in this affection the outer and inner tables of the skull escape, but it is only in the diploë that the pathological process is obvious to the naked eye.

The only treatment that has been suggested—trephining—does not offer any hope of alleviating the symptoms.

*b. Chronic osteitis.*—This may affect the bones of the skull without apparent cause, but in the majority of cases depends upon the syphilitic taint. Sometimes all the bones of the skull become thickened and enormously massive, the surface being much roughened and often worm-eaten. At other times irregular hyperostosis may be the result. Considerable thickenings of some of the cranial bones, the result of an imperfect vascular osseous deposit, are found in some infants affected with congenital syphilis. These are mostly met with about the fontanelles, especially on the frontal and parietal, and sometimes the temporal bones. The irregular hyperostoses are mostly the result of local periostitis; in fact, they are ossified nodes. Chronic osteitis is the cause of the falling-in of the bridge of the nose or the massive condition of the same part, which gives such a characteristic appearance to a child suffering from congenital syphilis.

The treatment must be directed against the constitutional taint, if any is to be discovered.

*c. Caries.*—Chronic osteitis can hardly be considered apart from caries, which, again, in the majority of cases, depends upon syphilis, though more rarely on the strumous diathesis. It is usually caused by the penetration of a superficial ulcer into the deeper structures, or by the separation of the periosteum, resulting from periostitis. It is frequently associated with more or less chronic osteitis and necrosis. One of the most frequent seats of caries of the skull is the forehead, as a sequence of tertiary syphilitic ulceration (*corona Veneris*). Another common seat is the hard palate, which is often perforated as the disease advances. Caries may occur in the occipito-atlantal articulation (Pott's disease), followed by a train of symptoms which will be found discussed in other parts of this work. Caries of the temporal bone, either of the petrous or mastoid portions, frequently follows *otitis media*, and is not uncommonly the intermediate stage between this disease and meningitis or cerebral abscess.

Beyond precautions for maintaining cleanliness, little or nothing can be done to relieve this condition by the surgeon; and with regard to other cases of caries of the skull, whether considered pathologically or clinically, nothing can be added which does not apply to the same disease in other parts of the body. Caries of the occipito-atlantal articulation is well treated in the early stages by the actual cautery.

*d. Necrosis.*—Necrosis of the skull not unfrequently depends upon a traumatic cause, such as scalp-wounds or burns; but here again the syphilitic form is exceedingly common. It may also depend upon disease of the middle ear. Simple traumatic necrosis leads to the separation of a sequestrum in the usual way. Syphilitic necrosis often depends upon some form of ulceration, or upon periostitis, and may be accompanied by extensive

caries and chronic osteitis. The separation of syphilitic sequestra is generally a remarkably tedious process; and they are, moreover, often surrounded by little or no reparatory callus, so that after their removal it is no rare occurrence to find the dura mater pulsating over a large area at the bottom of the wound. At the same time this rule is not invariable; it is common to find great thickening if necrosis of the bones of the orbit occur, which may cause permanent displacement of the eyeball. The writer has seen a large piece of the body of the sphenoid separated as a sequestrum, including the sella turcica, and removed through the nose without the slightest evil result to the patient.

Necrosis is not unfrequently met with affecting the bones of the face. Thus a part or the whole of the upper or the lower jaw may die, and be separated as a sequestrum. Necrosis of the jaws often depends on inflammation set up by carious teeth. Another cause, happily not now frequently met with, is the poisonous effect of the fumes of phosphorus in persons employed in the manufacture of this substance, and in that of lucifer matches (*see* PHOSPHORUS, Poisoning by). The same remarks apply to the abuse of mercury. But besides these more special causes, necrosis of the bones of the face may depend upon those more general states which are supposed to stand to necrosis of other bones in the relation of cause and effect; such as fevers and the like. The amount of thickening round a necrosed upper jaw has not unfrequently led to its removal in mistake for a tumour; it is, therefore, of the highest importance to examine all swellings in this region with great care.

TREATMENT.—If the membranes be left exposed, some protection must be provided for the cranial contents; otherwise the treatment of necrosis of the skull must be conducted on general principles. Sequestra in the mastoid process or around the tympanum should be carefully dealt with, on account of the danger of setting up meningitis, which any surgical interference involves. In dealing with necrosis of one half of the lower jaw it must be remembered that, unless sufficient callus have been thrown out before the removal of the sequestrum, the other half will lose its support and assume an altogether unnatural and almost useless position, leaving the patient in a condition in which he can hope for but little relief from surgery.

*e. Periostitis.*—Periostitis of the skull has been already referred to. It may depend upon syphilis or struma—most commonly the former, and gives rise to what are known as *nodes*. The inflammatory subperiosteal effusion may be fluid or solid (*soft* and *hard* nodes); and it may undergo true or spurious suppuration or ossification, or may be completely absorbed. The most common position for cranial nodes is the frontal bone. As in the case of periostitis elsewhere, nodes are the seat of characteristic nocturnal pain, which is extremely distressing and exhausting to the patient.

TREATMENT.—The treatment in any case is by the administration of iodide of potassium; the effect of which is most marked, however, in syphilitic cases, the pain being usually removed in two or three days. If suppuration occur, incision is required.

6. **Rickets.**—In a rickety infant the skull looks large; though it may be questioned whether this does not depend on a deficient development of the bones of the face. The frontal and parietal eminences appear too prominent; the fontanelles remain patent much longer than in a healthy infant; and in some cases the anterior fontanelle may be unclosed as late as the fourth or sixth year. The skulls of rickety children have a peculiarly massive feel; they are sometimes long in proportion to their width, conforming to the shape known as dolicocephalic. For a more detailed account of this and other conditions see a paper by S. J. Gee, M.D., in vol. vii. of the *St. Bartholomew's Hospital Reports*, on 'The shape of the head looked at from a medical point of view.' The head of an adult who has been the subject of rickets in his childhood, has often a very characteristic appearance; an apparently large square skull, with a prominent forehead towering above a diminutive and pinched-up face, giving to the individual a decidedly intellectual aspect.

Craniotabes occurs occasionally in rickety skulls, but, as will be afterwards shown, we do not yet know how far, if at all, it depends upon the constitutional condition.

7. **Craniotabes.**—By this term is meant the occurrence of spots of remarkable thinness in the skull, such that an indentation may be produced by the pressure of the finger. True craniotabes, as opposed to the gelatiniform degeneration of the outer table (Parrot), attacks the inner aspect of the skull. For its production an undue softness of the bone appears to be necessary, together with the occurrence of pressure, either from within or from without. It is rarely found congenitally, and then affects the anterior part of the skull. It is common in syphilitic infants under one year of age, and then affects usually the posterior parts of the parietal bones. These positions, it will be noticed, are those most subjected to pressure under the two conditions mentioned. Craniotabes has been, by some observers, associated with rickets, but the relation of the one to the other is at present doubtful. It disappears as age advances, and requires no special treatment. *See* M. Parrot, *Revue Mensuelle*, 1879, p. 769; and Dr. Barlow and Dr. Lees, *Pathological Transactions*, 1880, p. 236, and 1881, p. 323.

8. **Syphilitic affections.**—From the foregoing observations it will be seen that syphilis, congenital or acquired, has much to account for amongst diseases of the skull. It may cause periostitis, with consequent nodes; chronic osteitis, with consequent hypertrophy, local or general; caries; necrosis; and craniotabes. As a general rule, it may be stated that syphilitic affections of bone are amongst the later manifestations of this disease. The inflammatory forms are usually accompanied by severe nocturnal pains, and they may be expected in most cases to yield to the administration of iodide of potassium.

9. **Tumours.**—It is necessary to refer in the briefest possible way to the tumours of the skull. Primary growths may spring from the diploë, or from the inner and outer tables of the cranial bones. Perhaps the most common are exostoses

and some of the various kinds of sarcoma, either of which may reach an enormous size. The former may assume various characters. A remarkable instance of one presenting the appearance of a horn will be found described in the *Path. Trans.* vol. iii. p. 149. These alone, and then only in certain cases, admit of removal by the surgeon. In connection with the bones of the face, tumours of the antrum or of the upper jaw, of various kinds, and tumours of the lower jaw, are not uncommon. In the latter position the various forms of epulis—myeloid, fibrous or malignant, and cystic tumours are frequently met with. Exostoses often grow from the jaws and the orbit, and in connection with the latter the different kinds of odontoma must be mentioned. Secondary tumours of all kinds may affect the skull; thus more than one instance is on record of a pulsating growth, occurring secondarily to a similar growth in the thyroid gland. Of these secondary affections the commonest are those which affect the skull by the direct extension of tumours from within or without; for example, the epitheliomata of the scalp or mouth, or rodent ulcer of the face.

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**SLEEP, Disorders of.** — Synon.: Fr. *Troubles du Sommeil*; Ger. *Stöhrungen des Schlafes.*—A proper amount and kind of sleep is needful in order that the body may be maintained in a state of health. But the actual amount of sleep taken and necessary for persons in health varies, within wide limits, according to age, the soundness of the sleep itself, and individual idiosyncrasy.

Age is a very important modifying factor. Thus an infant may sleep for twenty hours out of the twenty-four, and young children up to the age of ten commonly sleep for fourteen or at least twelve hours. In children from ten to fifteen years old, the duration of sleep usually varies between twelve and ten hours. In persons from fifteen to twenty-five the period should not sink below eight hours; from the latter age on to fifty it may fall to seven hours; and after this age about the same amount of sleep is required by the majority of persons, though some find six hours sufficient, and a few can (without apparent injury) take habitually even as little as five hours' sleep. The instances in which a duration of sleep habitually less than this is needed, are altogether rare and exceptional.

Soundness of sleep, too, is subject to much individual variation. In childhood and in early life, sleep is commonly more profound than it is in adults, and much sounder than in old age. But over and above these variations incident to age, there are individual differences. Some persons are naturally 'light' and others 'heavy' sleepers. As a rule, those who can do with a small amount of sleep belong to the latter category. And similarly in regard to amount there are individual differences; some persons are able to do with a comparatively small amount, while others seem to require to sleep decidedly beyond the average periods above stated.

The disorders of sleep,—that is, the variations outside the above limits—belong to three principal categories, in the first of which may be ranged all those cases where sleep is *excessive* in amount; in the second those in which it is *defective* in soundness or in amount; and in the third those in which it is *unnatural in character.*

I. **Amount of sleep excessive.**—This occurs commonly in more or less demented persons or in idiots, whose brain-activity is below the usual level. Such persons, when their natural wants are satisfied, are apt, like the lower animals, to sleep away a large portion of their time.

But some individuals of notable intellectual power may occasionally, even in a state of health, though after greatly prolonged labours with previous deprivation of rest, continue to sleep soundly for twenty-four or even thirty-six hours.

In many brain-affections, and in some cases of blood-poisoning, a condition of unnatural sleep bordering upon stupor may be present for many days. Obscure cases in which sleep is prolonged for weeks, or even months, are occasionally met with in this country. This rare condition only supervenes in persons of an obviously 'nervous' temperament, and the state itself seems generally to be a kind of trance allied to catalepsy.

On the West Coast of Africa a curious endemic disease occurs known as the '*sleeping sickness*' (*see* Gore, *Brit. Med. Journal*, Jan. 2, 1875), the ætiology and pathology of which is altogether obscure. It begins with a swelling of the cervical glands, together with an increasing tendency to sleep. The somnolence becomes more and more constant, until at last the patient cannot even be aroused to take nourishment. The disease lasts from six to twelve months, and is generally fatal. *See* Trance.

II. **Amount of sleep defective.**—Under this head we have to do with two kinds of failure—a defect of quality (*disturbed* or *restless sleep*); and a defect in quantity (*wakefulness*, *insomnia*, *pervigilium*). These two defects often co-exist, though in many cases we may have the former condition existing alone.

(*a*) *Disturbed* or *restless sleep.*—This is a most common complaint, apt to occur in persons of all ages, and under the influence of many different causes, some of the most frequent of which are these:—indigestible food, or food of excessive or unaccustomed quantity, taken not long before going to bed; painful conditions of any kind; discomfort induced by undue cold or excessive heat; mental excitement or worry; prolonged overwork (mental); over-fatigue (bodily); febrile conditions; inflammations; gouty states of the system; imperfect action of the liver; excessive hæmorrhages; acute and chronic illnesses of various kinds; the state of convalescence from many acute diseases. Lastly, sleeping in a novel or uneasy condition, or in the midst of unaccustomed noises, may also be mentioned as a not unfrequent cause. Under any of these various conditions sleep may be fitful and disturbed, the persons often starting or turning about uneasily, dreaming much, and from time to time waking under the influence of dreams of a distressing or oppressive character. In one of the most extreme of the latter conditions, especially when it has been evoked by indigestible food, the state known as *nightmare* is induced. *See* Nightmare.

Treatment.—The treatment of disturbed sleep must of course vary widely according to the nature of the influences under which it has arisen. These may at times be easily corrected, but in other cases where the disturbed rest is dependent upon pain difficult to annul, or upon some acute or chronic disease, it may be impossible or extremely difficult to ensure sound sleep, notwithstanding the best directed efforts to correct or neutralize the disturbing causes in operation. It may then be necessary to have recourse to the measures recommended under the next heading.

(*b*) *Insomnia or wakefulness.*—Under this head we may have either complete or partial insomnia. The condition is complete when the person gets no sleep at all for night after night, as in acute mania, delirium tremens, in those suffering from some very severe pain, or in persons under the influence of profound grief or mental anxiety. On the other hand we may have partial insomnia of different kinds. In the one set of cases the persons who suffer from it may lie awake for long periods (one to several hours) before being able to get to sleep at all, and then sleep may be more or less sound and continuous till morning. In other cases patients do not experience so much difficulty in getting to sleep, though after they have slept for one, two, or more hours they awake and cannot again fall asleep; they lie awake often in a state of mental depression, or even actually tortured by gloomy or horrible forebodings.

Various cases are on record in which absolute insomnia has lasted not only for days but even for weeks, interrupted only by mere snatches of sleep during brief intervals.

In this whole class of cases, however, the sufferers themselves are apt to form exaggerated estimates of the amount of their wakefulness, and to become more or less hypochondriacal upon the subject.

Treatment.—In many of these cases the art of the physician is very severely taxed. Whenever it is possible, insomnia should be corrected by a studious attention to the general health and habits of the patient, and by endeavouring to ensure the presence, as far as possible, of the physiological conditions which favour sleep. Mental repose, bodily comfort, a sufficient degree of warmth, a certain amount of fatigue, combined with perfect quietude, are essentials. To ensure the first of these conditions it may be needful to prohibit all study for some hours before retiring to rest. An evening walk, so as to induce a certain amount of bodily fatigue, is often beneficial where it can be had recourse to. A cup of warm beef-tea, gruel, or some weak stimulant just before going to bed may also have a salutary influence, and the former may be repeated, or taken preferentially, during the night. Monotonous sensorial impressions (sounds or gentle frictions); or a monotonous dwelling of the mind upon certain uninteresting imaginary sights or verbal repetitions are, again, not unfrequently found to act as provocatives of sleep.

Where such measures are unavailing, recourse must be had to hypnotics and sedatives, such as bromide of potassium, chloral, opium in one or other of its forms, morphia by mouth or subcutaneously, hyoscyamine, Indian hemp, &c., in doses appropriate to the age and condition of the patient. In the more urgent cases the doses of such hypnotics may have to be repeated till sleep is procured; but in many of these urgent conditions the sedative influence of packing in the wet sheet must not be forgotten. Where hypnotics are had recourse to, it is of great importance to see that their use is not continued after the need for them has passed. Abrupt discontinuance is often most inadvisable, but rather a gradual diminution of the dose, with or without the knowledge of the patient.

**III. Sleep unnatural in character.**—Under this head we have to do with various unnatural conditions, in which the abeyance of function characterising sleep is more partial than that which normally exists. In disturbed sleep the physiological condition pertaining to sleep is generally less profound than it should be, just as in other cases of unusually deep sleep (akin to stupor) such a condition is generally more profound than natural. In the cases to which we now refer, however, sleep is partial in its area; portions of the brain that are usually involved in the physiological condition peculiar to sleep remain exempt, so that the sleeper exhibits powers which sleep usually annuls. Hence we may have *somniloquy* or *sleep-talking*; and *somnambulism* or *sleep-walking*. In those who exhibit the former phenomena, dream-thoughts are capable of evoking correlative acts of speech, and such persons will sometimes allow a listener to hold a sort of conversation with them, of which in the waking state they recollect nothing. This dream-conversation may be more or less coherent. Dreams themselves, too, vary much in their coherency in different individuals. In some persons whose sleep is to that extent unnatural, powers are displayed which even surpass those of the waking state. Mathematical problems have been solved during such sleep; poems and music have been composed and written out, which have altogether surprised the same person when awake. The writer has recently seen a young lady liable to what may be termed 'singing fits,' in which she would lie for hours incapable of being aroused by ordinary means, singing without intermission songs, hymns, and portions of operas in promiscuous succession, but in a manner very decidedly excelling that of which she was capable when awake. In all these states we have to do with a morbid condition of sleep, partial in its area, and in which there is the further peculiarity that certain faculties are in a condition of exalted activity. The alliances here are intimate with the conditions that have of late been studied under the name of 'hypnotism,' but which were formerly included under the term animal magnetism (*see* Magnetism, Animal). The same remark applies to somnambulism also. Here the morbid sleeper possesses an unwonted power of calling his muscles generally into activity in response to his dream-thoughts. Sight in relation to the dream may be good, though unrelated visual impressions are not taken cognizance of. Muscular sense-impressions also are freely acted upon, but the sleep-walker may be quite deaf to all ordinary auditory impressions.

Treatment.—These are to be regarded as distinctly morbid conditions, and the persons manifesting them may often be cured by attention to the general health, and the use of remedies calculated to give tone to, and allay the irritability of the nervous system. A line of treatment, in fact, not very dissimilar from that to which one would have resort in convulsions or epilepsy, will often suffice to cure these minor manifestations of nervous disorder.

Finally sleep may be disturbed by certain phenomena occurring to the person in this condition, which, though scarcely to be spoken of as disorders of sleep, ought at least to be mentioned under this head. One of minor significance is snoring, which at times may be so loud as to awaken the sleeper; but another of far greater significance is the tendency to the occurrence of convulsive or epileptic attacks, which in some patients occur only during sleep.

H. Charlton Bastian.

**SLOUGH** (Sax. *Slog*, a foul hole or hollow).—The dead material resulting from gangrene, ulceration, or low forms of inflammation of soft tissues. A slough may be in the form of a mass, as in gangrene; or in shreds, as in ulcers and unhealthy wounds, which are then said to be *sloughing*. *See* Gangrene; and Ulceration.

**SMALL-POX.**—Synon.: Variola; Fr. *la petite Vérole*; Ger. *Blattern*.

Definition.—An acute specific, infectious disease, characterised by sudden and severe fever, which after forty-eight hours is followed by an eruption of pimples on the forehead, face, and wrists, gradually passing over the body. This eruption is followed by a fall of temperature, and in from ten to fourteen days it passes through the stages of vesicle, pustule, and crust; it also appears on certain mucous membranes, and is sometimes complicated with hæmorrhage into the skin, and from the mucous surfaces.

Ætiology.—When, where, or how small-pox arose is not known. It certainly appeared in Europe in the sixth century. It arises now from contagion and from inoculation. It affects all races of men, every age, and both sexes. No climate is free from its ravages. It rages with special virulence where it appears for the first time, and in such cases may carry off whole tribes. It is exceptionally severe among negroes and the inhabitants of warm climates generally. Its subjects are unvaccinated or badly vaccinated persons, extensive observation having shown that in proportion to the efficiency of vaccination is the rarity and mildness of small-pox. As a rule it attacks the same person once only, but there are exceptions to this rule. Some few—of whom Morgagni, Boerhaave, and Diemerbroek are said to have been examples—are insusceptible of small-pox.

Anatomical Characters.—Small-pox is the result of a specific morbid poison, which, after a period of incubation of about thirteen days, possibly sometimes less, manifests itself by high fever and an eruption on the skin. The eruption is sometimes preceded by rashes of an erysipelatous, scarlet, or measly character, chiefly seen on the lower abdomen, the groins, and the upper and inner part of the thighs, along the sides of the chest and about the axillæ. Sometimes they are seen upon the face and neck, and occasionally they cover the body. They are distinguished from the hæmorrhagic rashes by the absence of blue-black spots, and are usually associated with the milder cases. 'As regards the skin-eruption, the papules are due, in the first instance, partly to punctiform hyperæmia of the cutis, over which the epidermic cells, and more especially those of the superficial portion of the rete mucosum, become swollen. By degrees, serous fluid is poured out into the substance of the affected epidermis, raising the horny layer from the swollen group of cells below, but detaching it imperfectly, so that a number of small irregular intercommunicating serous cavities are produced. But soon suppuration occurs in the subjacent rete mucosum, and the pus-corpuscles then rapidly diffuse themselves, and the pock is converted into a pustule. The umbilicated character which is so common is due to the presence either of a hair or of a sudoriparous gland, the connection of which with the subjacent true skin has not yet been destroyed. The suppurative process need not implicate the true skin below; but not unfrequently it involves and destroys it to a greater or less depth, and is prolonged inwards along the hairs or glands. Under the former circumstances the pustule leaves no permanent trace; under the latter a depressed cicatrix results, presenting numerous pits upon its surface.' (Bristowe, *Theory and Practice of Medicine*.)

*Post-mortem* examination shows nothing beyond external appearances, special to small-pox, except a trace of eruption on the larynx and vocal cords. The blood is in most cases imperfectly coagulated, and in black cases not at all. In the latter ecchymoses of the mucous and serous membranes will be found. Pleuritic effusions and pneumonic consolidations are sometimes found, but the most common lung-complication is broncho-pneumonia. In variola hæmorrhagica pustulosa hæmorrhage is generally found in the substance of the lungs, heart, kidneys, and liver.

Symptoms.—Small-pox may be described under six forms:—(1) discrete; (2) confluent; (3) hæmorrhagic pustular; (4) malignant; (5) inoculated; (6) small-pox after vaccination and revaccination (modified).

(1) **Discrete.**—In the discrete form the disease begins with rigor, fever, lumbar pain, headache, and sickness, with copious perspirations; followed by an eruption on the forehead, face, and wrists. This is usually most abundant on these parts, next most abundant on the hands and feet, and least so on the limbs and trunk. The eruption is followed by a remission of the general symptoms, and a fall of temperature, which continues until about the eighth day, which, in this article, is always the day of disease. Between the third and the eighth days the pimples appear on the extremities and the trunk, and change into greyish-white vesicles, circular, flattened, depressed in the centre, and surrounded by a red ring. During this time also vesicles may be seen in the mouth and the upper part of

the pharynx and larynx, and there will be some soreness in these parts. On the eighth day some of the vesicles become pustular, lose their central depression, and become globular, whilst the redness which surrounds them becomes more marked. With this change the temperature rises, and the general symptoms return; but these are of short duration, for the pustules either dry up rapidly and form scales, or burst and form scabs; the temperature falls by about the tenth day; and the patient is then convalescent, fatal results being extremely rare, except in unvaccinated children under one year. When the crusts have fallen, and the desquamation which follows them is complete, there will often be pitting.

(2) **Confluent.**—In this form the initial symptoms are essentially the same as the former, but more severe. The eruption appears about the same time, and in the milder varieties is discrete until the disease has reached the vesicular or the pustular stage; but in the more severe forms it is confluent from the first, and instead of showing distinct closely packed papules, the whole face is swollen, presenting the appearance of a tense elastic mass. When the eruption is well out the temperature falls, and the general symptoms remit, but to a less extent than in the discrete variety, and this remission continues until about the eighth day. Up to this time more or less delirium is present in many cases, and it is sometimes maniacal and suicidal in character: drowsiness and stupor sometimes take its place, and occasionally alternate with it. On this day, the eighth, the vesicles begin to become pustular, the areola to deepen, the temperature to rise, and the general symptoms to return. At the same time the face becomes extremely swollen; the eyelids close from œdematous swelling; saliva flows copiously from the mouth; the glands, and the subcutaneous tissue of the neck and lower jaw enlarge; and the early delirium usually disappears. One of three things may now take place:—(1) the disease may go on regularly to the eleventh day; (2) the development of the pustules may cease, the face remaining flat, of an opaque white colour; or (3) hæmorrhage may take place into the skin beneath the vesicles, and from the mucous membranes, that is, may become hæmorrhagic pustular. In either of the last two events death is almost invariable, and often rapid. In the first the swelling of the face increases for the next three days, during which time the vesicles become pustular, and the hands and feet swell. There will be increased sore-throat, increased salivation, great thirst, sleeplessness, delirium, rising temperature, and occasionally laryngitis. On or about the eleventh day the temperature and the general symptoms will have reached their height, the pustules will discharge their contents, and crusts will form. After this, in favourable cases the temperature will begin to fall, and the symptoms of the so-called 'secondary fever' to decline. By the fourteenth day crustation will be complete on the face, where it is most commonly found, the general symptoms will have disappeared, the temperature will have become normal, and convalescence established. In unfavourable cases it is about this time, the eleventh day, that death usually occurs. It is preceded by low delirium, variable temperature, subsultus, involuntary motions, and occasionally hæmorrhage into the skin and the pustules. When the crusts, which in this form are often retained many weeks, fall off, and when the desquamation is complete, there is pitting, which, at first of a reddish-brown colour, in process of time becomes white.

(3) **Hæmorrhagic, pustular, or vesicular.**—This form of small-pox constitutes the connecting link between the confluent and the malignant. With the latter it is often confounded, and hence true malignant has sometimes been said to end in recovery. It is characterised by hæmorrhage into the skin beneath the vesicles or the pustules. There are generally petechiæ, sometimes ink-spots, and often subcutaneous hæmorrhage. Recovery is very rare. Death may take place in the vesicular or the pustular stage.

(4) **Malignant.**—Synon.: *Variola nigra; Variola hæmorrhagica*; Black Small-pox; *Purpura variolosa.*—This form is invariably fatal. Its distinguishing features are hæmorrhage into the *skin*, and irregularity in the form of the eruption. The illness commences with the ordinary symptoms, but accompanied by marked lumbar pain, præcordial anxiety, and coldness of the extremities. This is followed, about the third or fourth day, by ecchymosis into the conjunctivæ, and a purpuric or scarlatiniform rash, sometimes covering the whole body, but most marked over the lower abdominal region, and the upper and inner part of the thighs, in which rash large and small dark blue, deep violet, or black spots are seen. The ordinary eruption is sometimes entirely absent, or when present is very meagre and much modified. In the majority of cases it is limited to a few scattered vesicles, more often found on the fingers and toes than elsewhere. With these appearances there will often be found on the skin hard tumours, of variable size, of the same colour as the spots; and from one or more of the mucous surfaces there will be bleeding. Death sometimes takes place as early as the third day, most commonly on the fifth, rarely later than the seventh. The temperature usually fluctuates about 102° (Fahr.), sometimes reaches 104°, and is sometimes nearly normal during the whole course of the disease. The mind is almost always clear throughout. This form of small-pox has received so little mention of late years, although it is well described by Sydenham, that the writer thinks notes of a few cases will be useful:—*E.B.*, æt. 24, unvaccinated. Condition on fourth day:—Very restless, pulseless; losing blood from vagina; repeated vomiting; some papular eruption with ink-black spots; bruise about the size of a shilling over the insertion of the right deltoid. Mind clear. Fifth day:—Patient called the nurse, who had just left the bedside, on immediately returning to which she found the patient dead. *J. W.*, æt. 28. One fair vaccination-mark and one bad. Illness commenced with lumbar pain and vomiting. On the fourth day:—Face red and swollen; papular eruption on hands, and general erythematous rash, with spots like leech-bites; hæmoptysis; temperature 100·4°. Mind clear. Sixth day:—Left eye black; blue spots on face; hæmaturia; hæmoptysis; feeble pulse; temperature 99°. death. *J. L.*, æt. 23, three good vaccination-marks.

On fourth day:—Anxious and restless, with general scarlatinous rash, most marked over the groins and lower abdomen, of a brick-red colour, with many lead-coloured spots; face natural, except for conjunctival ecchymosis and bruised eyelids; lead-coloured spots on the sides of the trunk and borders of the axilla; petechiæ on legs; a few vesicles between the shoulders; mind clear; temperature 101°; continued much the same until the morning of the seventh day, when hæmoptysis occurred, and the patient died; temperature 98·6°. This form of small-pox occurs at all ages, and in both sexes. It is never found in well-vaccinated subjects under fifteen, nor in those who have been efficiently revaccinated about that age.

(5) **Inoculated.**—On the second day of inoculation a pimple rises, which by the fourth has developed into a vesicle, and by the seventh or eighth into a pustule, when the patient has rigors, swelling and pain in the axillary glands, and more or less fever, followed on the eleventh day by the ordinary small-pox eruption (Bristowe), which passes through the usual stages. The inoculated pustule attains full development on or about the eleventh day, and by the fourteenth there will be a crust. The characteristic of the disease thus induced is its mildness. It protects from small-pox in the same degree as first attacks of that disease protect from second attacks. The objections to it are (1) that small-pox so induced is infectious; and (2) that it is sometimes fatal.

(6) **Small-pox after Vaccination and Revaccination.** (*a*) *After vaccination.*—Speaking generally it may be said that *good* vaccination protects from small-pox, and that when it does not protect absolutely it renders the disease milder, the disfigurement less marked, and reduces the mortality directly as the efficiency of the vaccination and revaccination. Persons under fifteen years of age with two good cicatrices are very rarely the subjects of severe small-pox, and if they contract it, death is almost, if not quite unknown. After this age, however, certain, chiefly inefficiently vaccinated, persons become again susceptible, and the disease in some of these is occasionally severe. Post-vaccinal small-pox may be described under the following three forms:—(1) In one class of cases there is more or less feeling of illness, headache, slight fever, possibly some lumbar pain, followed on the third day by a sparse eruption of papules, which abort and soon disappear. (2) In another class there are severe initial symptoms, followed on the third day by an eruption of papules, and a remission of the fever. On the fifth day the papules will have become vesicles, which in a day or two dry up without any recurrence of fever, leaving the patient convalescent at the end of a week. (3) In a third class the initial symptoms are very severe, sometimes indistinguishable from those of confluent small-pox, and they last forty-eight hours, after which an abundant eruption comes out, the whole face swelling as in severe confluent. The temperature now falls, and the disease in some cases will abort at this stage; in others it will go on to the vesicular stage and then abort, the patient becoming convalescent about the end of a week, without any recurrence of fever. In the case of adults who have been vaccinated only in infancy, and in children who have been badly vaccinated, the disease may run an unmodified course and end fatally.

(*b*) *After revaccination* (successful). Small-pox, after this, is practically unknown. During the epidemic of 1871, 110 persons were engaged in the Homerton Fever Hospital in attendance upon the small-pox sick; all these, with two exceptions, were revaccinated, and all but these exceptions escaped small-pox. The experience of the epidemic of 1876-77 was of the same kind, all revaccinated attendants having escaped, whilst the only one who had not been vaccinated took the disease and died of it. So, in the epidemic of 1881, of 90 nurses and other attendants of the Atlas Hospital Ship (small-pox) the only person who contracted small-pox was a housemaid who had not been revaccinated. At the same time a single efficient revaccination about puberty is not, in the writer's opinion, an effectual protection, even against death, for all time.

Course, Termination, Complications, and Sequelæ.—In the discrete form of small-pox the great majority of cases recover; half of the confluent cases die about the eleventh day, and the malignant cases invariably die. In small-pox modified by vaccination the course of the disease will depend upon the quantity and quality of this, as shown by the marks. If these be of the best kind, three or four in number, and in a patient under fifteen, the disease is invariably mild. In some, however, who have passed puberty, the best primary vaccination loses in power; but nevertheless, it almost invariably modifies the disease, and when death occurs it is usually due to some accidental complication. Of complications, laryngitis, bronchitis, pneumonia, and in particular broncho-pneumonia, are the most common. Glossitis occurs occasionally. On two occasions the writer has met with cerebral symptoms, which were shown after death to depend upon cerebral hæmorrhage. Aphasia with right hemiplegia he has seen twice; and once a condition like dementia, shown after death to depend upon thrombosis of the basilar artery. In the cases of cerebral hæmorrhage the eruption was not fully developed, but at the time of death they did not seem likely to become cases of extreme confluence. One was in a girl twenty-one years of age, with two good vaccination-marks; and the other in a boy of eight with four fair marks. In both cases the event occurred in patients who suddenly became dangerously ill, and the seriousness of whose illness could not be ascribed to a small-pox which was by itself mild. It may be that this would be found to be the *immediate* cause of death in other cases, if post-mortem examination were more frequent and complete. It has been said that small-pox is occasionally complicated with scarlatina or measles; and Dr. Murchison, Professor Monti of Vienna, Dr. Theodore Simon of Hamburg, Mr. Marson, late of the London Small-pox Hospital, and others have published cases in support of this. There is no doubt that *eruptions* indistinguishable from those of scarlatina and measles, appear in many cases of variola; but whether the presence of such eruptions, which are but *one* symptom, constitute evidence upon

which to maintain the co-existence of two specifically distinct diseases—an opinion which has the support of Trousseau (*Clinique Médicale*, vol. i. p. 32, edition 1868)—may be doubted. Pregnancy has been said to be a grave complication of small-pox. It is certain, however, that many pregnant women recover without injury; but abortion in confluent cases is often fatal, on account of the attendant bleeding. Of sequelæ the most common is pitting. Mania and dementia are occasionally seen. Erysipelas, abscesses, gangrene of the extremities, particularly the tips of the hands and feet, enlargement of the glands of the neck, conjunctivitis, iritis, perforating ulcer of the cornea, are not uncommon, and then occasionally one or both eyes may be destroyed. The specific small-pox eruption, however, never appears on the corneal conjunctiva. The changes which take place in the eye are late in the disease, and in all probability due to defective nutrition. Otitis, parotitis, orchitis, and ovaritis occur sometimes; and pyæmia occasionally.

Diagnosis.—This cannot be made with certainty until the eruption appears. Fever, headache, lumbar pain, and vomiting during the time of an epidemic of small-pox, should arouse suspicion; and should these be followed after forty-eight hours by an eruption of papules on the forehead, face, and wrists, the diagnosis may be considered certain. The difficulty of exact diagnosis depends on the fact that in many cases all the main features are not present together, and that one begins to trust to the existence of some one prominent symptom. Fever with headache, backache, and vomiting *may* occur in continued fevers; but the later appearance of the eruption, and the fact that it is not found in the situations in which that of small-pox occurs, ought to negative the idea of small-pox. Small-pox is occasionally preceded by eruptions which simulate those of measles, scarlatina, or erysipelas, and these eruptions are associated with fever and other symptoms of constitutional disturbance. If the disease be small-pox, the eruption will change within twenty-four or thirty-six hours, or will show signs of malignancy. Pyæmia, glanders, and acute rheumatism with a pustular eruption, may also be mistaken for small-pox, but attention to the *history of the case* will be enough to enable one to form a correct opinion. So far as eruption alone may lead to error, the point for diagnosis turns on the query, Could the eruption have reached, or would it not have gone beyond its existing stage, if the disease on which it depended were small-pox? Of eruptions unattended by general symptoms, syphilides, acne, eczema, erythema, and urticaria are most frequently mistaken for small-pox; but mistakes of this kind may in most cases be avoided by a careful consideration of the *history*. Lumbar pain is found with fever in pneumonia, but physical examination of the chest ought to settle the question; moreover, there is no eruption beyond occasional herpes. In lumbago there is no fever. Labour-pains are unattended by fever; moreover, they usually come on gradually and in the belly first, and are not constant. It must be borne in mind, however, that pregnant women, when suffering from small-pox, may have labour-pains and the initial symptoms of small-pox concurrently. Cases of black or malignant small-pox will present little difficulty; but if scarlatina, measles, and typhus prevail at the same time, there will be great difficulty in arriving at an exact diagnosis as to which form of malignant fever exists in the case under observation. The diagnosis from chicken-pox has been treated of in that article. *See* Chicken-pox.

Prognosis.—This will have been gathered from what has preceded. Small-pox is most fatal in unvaccinated children under five, and in adults over thirty. At these periods of life half or more may die. The lowest mortality in the unvaccinated occurs from ten to fifteen. The discrete form is rarely fatal in adults, but it is so occasionally when it occurs in unvaccinated children. Half of the confluent cases will die, and of the malignant all, and nearly all children under one year, whatever form the disease may assume. As regards vaccination in prognosis, it may be stated generally that the unvaccinated will die at the rate of about 50 per cent., the badly vaccinated at the rate of about 26 per cent., and the well vaccinated at the rate of about 2·3 per cent. *See* Vaccination.

Treatment.—There is no specific for small-pox, its complications or sequelæ, and the treatment is therefore to be conducted on general principles. The following are points of importance:—(1) The patient should be placed in a large, well-ventilated room. He should be fed at intervals on easily digestible food, such as milk, beef-tea, chicken broth, and eggs beaten up; and occasionally, according to habit, a little wine or spirit may be given. He should be permitted to drink iced water or iced lemonade as he pleases. He should have a feather-bed, the sheets ought to be of the softest material, and the coverings light; and there should be two beds in the room, in order that the patient may be changed daily. (2) Two competent nurses should be obtained, one to attend the patient by day, the other by night, and these should never *for a moment* lose sight of him. (3) The hair should be cut short. (4) Heat of skin should be relieved by cold-water sponging, and the swelling of the eyelids and other painful parts by the constant application of cold compresses. (5) To relieve itching olive oil may be used, or, what is better, vaseline, which applied as a dressing to the face will facilitate the removal of scabs; and to destroy the disagreeable odour, some kind of deodorant, such as sanitas powder, should be sprinkled about and over the patient's face and bed. (6) To procure sleep, opium; or some form of alcohol, diluted with warm water, may be given. (7) Salivation should not be interfered with, but the mouth should be kept clean, and sedatives avoided during its continuance. (8) When delirium is marked, in addition to the nurse there should be an attendant, one accustomed to deal with lunatics, and of some bearing if possible. Mechanical restraint should be avoided, and the 'strait jacket' and 'tying down' strictly forbidden. The patient ought not to be left for one moment alone, otherwise he may have to be looked for wandering along some street, or drowned in the nearest water-course. He should never be argued with, and never flatly contradicted. If he should imagine

his attendants are bent upon injuring or killing him, they should be changed. If he be excited by the mere presence of others, as may happen in hospital wards, he should be treated by himself in a dark room. Should he persist in getting out of bed and putting on his clothes, in walking about his room, or in sitting over the fire, he should be permitted to do so, for to the fretted and fevered patient moving about is a relief. In maniacal delirium chloroform may be administered. (9) The eyes should be carefully watched, and in severe cases an ophthalmic surgeon should be consulted. (10) About the eleventh day laryngitis often supervenes, and for this tracheotomy should be performed when there arises distinct difficulty of breathing. Although in the majority of such cases the patient dies, the relief from suffering is so great that the operation should be performed. (11) When crusts begin to form about the nostrils they should be removed, and generally the patient should be kept in bed until suppuration under the crusts has ceased and the skin is healed. (12) Abscesses should be opened when they appear, and a water-bed should be ordered at the same time. (13) The patient may be discharged safely when the crusts and scales have disappeared, and not less than six baths have been given, at intervals of two days. Such is the general treatment of confluent small-pox; in the discrete kind little is needed; in the malignant none is of any avail.

The prophylaxis of small-pox is discussed under VACCINATION. ALEX. COLLIE.

**SMELL, Disorders of.** *See* NOSE, Diseases of; and OLFACTORY NERVE, Morbid Conditions of.

**SNAKE-POISONS.** *See* VENOMOUS ANIMALS.

**SNEEZING, Excessive.** — SYNON.: Fr. *Coryza spasmodique*; Ger., *Niesekrampf.*

DEFINITION.—An affection characterised by frequent and uncontrollable attacks of sneezing, out of all proportion to the nasal secretion.

ÆTIOLOGY.—The causes of excessive sneezing may be broadly classified as *extrinsic* and *intrinsic*. *Extrinsic* causes include especially various vegetable substances in the form of powder, of which tobacco-snuff is the type, and the pollen of certain plants (*see* HAY FEVER). The *intrinsic* conditions in connexion with which the affection occurs vary considerably. In some cases it is associated with whooping-cough and asthma, and it is not uncommon in gouty persons. It is sometimes a symptom of the hysterical condition, and not unfrequently associated with disordered menstruation, or some other derangement of the sexual functions. It has been met with in pregnancy, and even during more than one pregnancy in the same person, ceasing in the intervals, and has been supposed to replace morning-sickness (Barnes). In some persons a bright light or intense colour is sufficient to determine an attack of sneezing.

SYMPTOMS.—The morbid sneezing has no special characters. It is distinctly a reflex act, being excited usually by some slight impression on the fifth nerve. A slight catarrhal condition of the nasal mucous membrane is common. The secretion has been thought to be, in some cases, of a specific character, analogous to that of hay fever.

TREATMENT.—The attack itself may be usually cut short by a strong impression on some branch of the fifth nerve; when this fails, a mustard poultice to the back of the neck, or an emetic, may be employed. Atomised astringent nasal inhalations, or the vapours of creasote or iodine are useful. The immersion of the head in cold water has been recommended. Any irregularity in the functions of the genital or other organs must be attended to; and iron, quinine, and arsenic, if not otherwise objectionable, are useful in removing the liability to the complaint. *See* CATARRH; and HAY FEVER. W. R. GOWERS.

**SNUFFLES.**—A popular term for the condition in which a nasal discharge exists in children suffering from congenital syphilis. *See* SYPHILIS.

**SODEN, in Taunus, Germany.**—Common salt waters. *See* MINERAL WATERS.

**SOFTENING.** — SYNON.: Fr. *Ramollissement*; Ger. *Erweichung.*—A term of pathological significance, implying that an organ or tissue has a degree of consistence less than that which is natural to it. This is a condition which occurs in various organs or parts (1) as a result of pathological changes *during life*; and (2) as a consequence of different *post-mortem* influences.

(1) **Intra-vitam softening.**—With regard to the first order of changes, the brain and the spinal cord are the organs in which these conditions are most common, and in which it is apt to assume its most typical characters (*see* BRAIN, Softening of; and SPINAL CORD, Softening of). It occurs also in the osseous system (*see* BONES, Diseases of). The liver and spleen may likewise be softer than natural, and so may the mucous membrane of the stomach or intestines, or the tissue of the heart. In nearly all such cases the principal cause of this diminished consistence is a fatty degeneration or infiltration, associated with more or less of serous infiltration (*see* FATTY DEGENERATION, and the diseases of the several organs mentioned). This pathological condition is the reverse of those conditions of induration known by the name of *sclerosis* in some organs, and *cirrhosis* in others. *See* SCLEROSIS.

(2) **Post-mortem softening.**—The softening due to the definite pathological processes just referred to as occurring during life, has to be clearly discriminated from certain softenings which may supervene after death as a result of traumatisms or mere *post-mortem* changes. Thus the tissue of the brain or of the spinal cord, in some parts, may be diminished in consistence, and rendered more or less pulpy, owing to its having been bruised during the operations necessary for exposing these organs to view. The same organs likewise diminish in consistence by mere lapse of time after death, and the more quickly in proportion to the heat of the weather. In the stomach also *post-mortem* softenings are most prone to show themselves, should the organ contain gastric juice at the time of death. Here we get softening first, and afterwards solution of

the mucous membrane and other tissues of the organ. *See* STOMACH, Softening of.

H. CHARLTON BASTIAN.

**SOLIS ICTUS** (Latin).—A synonym for sunstroke. *See* SUNSTROKE.

**SOMNAMBULISM.**—Sleep-walking. *See* SLEEP, Disorders of.

**SOMNILOQUY.**—Sleep-talking. *See* SLEEP, Disorders of.

**SOMNOLENCE.**—An unnatural drowsiness or disposition to sleep. *See* SLEEP, Disorders of.

**SONOROUS RÂLE.**—A variety of dry *râle* or rhonchus, of a low-pitched character, resembling snoring and similar sounds, and produced in the larger air-tubes. *See* PHYSICAL EXAMINATION; and RHONCHUS.

**SOPOR** (Lat.).—An unnatural deep sleep, from which the patient can only be roused with difficulty. *See* CONSCIOUSNESS, Disorders of.

**SOPORIFICS** (*sopor*, heavy sleep).—SYNON.: Fr. *Soporifiques*; *Soporatives*; Ger. *Einschläfernde Mittel.*—A synonym for hypnotic agents. *See* NARCOTICS.

**SORDES** (Lat., filth).—DEFINITION.—Crusts which form upon the lips and teeth of persons suffering from extreme exhaustion.

DESCRIPTION.—Sordes occur commonly in what is called the typhoid state, whether this be due to typhoid or puerperal fever, pneumonia, or any like disease. They appear first as thin, light-yellowish crusts upon the prolabia, generally in close proximity to the teeth; gradually increase in thickness and in area; and, changing their colour to brown, or even black, at length extend to the adjacent surfaces of the teeth. They seldom or never cover those portions of the teeth which are hidden by the lips, but spread over their exposed surfaces; so that, as the patient lies with slightly parted lips, they bridge over the interval in the form of a narrow band upon the middle of the incisors of the upper jaw. When the lips are more widely separated, the sordes do not extend, unless in conditions of extreme exhaustion, over the whole of the exposed surfaces of the teeth, but form two ridges, corresponding with the margins of the upper and lower lips.

Sordes are composed of various schistomycetes, mingled with *débris* of food and epithelium. Micrococcus occurs almost constantly; bacillus subtilis frequently; and the writer has found, each in a single instance, sarcina ventriculi and spirochæta plicatilis.

PATHOLOGY AND TREATMENT.—These organisms, which are of constant occurrence on the papillary surface of the healthy tongue, are easily dislodged from the smooth lips and teeth. But in conditions of great prostration, especially when the prostration is associated with delirium, the slight frictions necessary for their removal are not made, and they obtain so firm a hold that they can only be removed by careful and repeated cleansing. Such cleansing may with advantage be performed with a piece of soft rag, or a brush dipped in a weak solution of Condy's fluid.

HENRY T. BUTLIN.

**SORE-THROAT.**—A popular name for various affections of the pharynx, larynx, and tonsils. *See* LARYNX, Diseases of; PHARYNX, Diseases of; THROAT, Diseases of; and TONSILS, Diseases of.

**SOUFFLE** (Fr.).—A soft, blowing sound. The term is applied either to the respiratory murmur heard over the lungs; or to certain murmurs heard in connection with the heart or blood-vessels. *See* PHYSICAL EXAMINATION.

**SOULZMATT, in France.**—Alkaline table-water. *See* MINERAL WATERS.

**SPA, in Belgium.**—Iron waters. *See* MINERAL WATERS.

**SPAIN, Southern.** *See* MALAGA; and CLIMATE, Treatment of Disease by.

**SPANÆMIA** (σπανὸς, rare, and αἷμα, blood).—A condition of blood, in which the amount of its solid constituents is below the normal, the blood then appearing thin. *See* ANÆMIA; and BLOOD, Morbid Conditions of.

**SPAS.** *See* MINERAL WATERS.

**SPASM.**—SYNON.: Fr. *Spasme*; Ger. *Krampf.*

DEFINITION.—A name given to abnormal contraction, occurring either in muscular organs, in single muscles, or in groups of muscles.

1. *Spasm of muscular organs.*—Concerning spasms of organs not much requires to be said here. We may cite as instances those spasms which occur in the pharynx in hydrophobia; the contractions of the œsophagus in œsophagismus and in some cases of hysteria; the painful contractions of the intestine which are presumed to occur in certain cases of colic; of the lower end of the rectum in tenesmus; of the bladder or of the urethra in certain cases of inflammation with irritability; of the vagina in vaginismus; of the uterus in rare cases of sudden abortion resulting from shock; possibly of the heart in certain diseases of that organ; of the vessels in various regions of the body, and on various occasions, from over-action of vaso-motor nerves; of the bronchial tubes in certain cases of asthma and hay-fever; of the glottis in laryngismus stridulus, and in pertussis; as well as of the gall-ducts or ureters under conditions of irritation, either direct or reflex. In reference to many of these conditions the reader may refer to special articles in which they are considered. All are due to excessive nervous stimuli, maintaining conditions of muscular contraction, which are unusual both in degree and in duration. These spasms are, therefore, tonic in type, and in almost all the cases cited it is involuntary muscular fibres that are involved.

2. *Spasm of single muscles or of groups of muscles.*—The next class of spasm is that which affects the striped or voluntary muscles. They are divisible into two main categories, that is, into *tonic spasms*, in which the contractions are uninterrupted, and *clonic spasms*, in which contractions and relaxations occur in quick succession; the former being typified by cramps, and the latter by convulsions.

Under *tonic* spasms, we may have cramps of brief duration, affecting a single muscle, such as

the diaphragm in hiccup; or of prolonged duration, as in the sterno-mastoid in certain cases of wry-neck. The tonic contraction may affect several muscles at the same time, as in lock-jaw, or the painful cramps which occasionally occur in the calves of the legs, or in other parts of the body. Such local spasms occur also in the conditions known as tetany, in conjugated deviation of the eyes, and in writer's cramp; likewise in spasmodic spinal paralysis, in hysterical paralysis, and under various conditions of irritative organic disease implicating motor nerves, or motor centres or tracts, either in the spinal cord or in the brain. More general tonic spasms occur in catalepsy, in tetanus, and in strychnia-poisoning.

This whole class of tonic spasms is supposed to be due to irritation, mechanical or chemical (nutritive), operating *directly*, either upon motor centres or upon the fibres conveying motor incitations in some part of their course between the brain and the muscles. In other cases, however, tonic spasms are of *reflex* origin, and the cause of irritation operates in or upon sensory surfaces, nerves, or centres.

*Clonic spasms* are also of various kinds. They may be limited to single muscles, such as the orbicularis palpebrarum; or they may affect particular groups of muscles, such as those of one side of the face, or the muscles of the lower jaw on both sides, or certain of the abdominal muscles, or some of the foot muscles, as in ankle-clonus. In other cases clonic spasms may be more general, taking the form of unilateral or of bilateral convulsions. The latter also may be irregular or of co-ordinated type. *See* Convulsions.

Where clonic spasms are much slighter in degree and in range, affecting some muscular fibres and that to a small extent, rather than entire muscles in a more marked manner, we have the production of *tremors*, which may be either fine or coarse, local or general.

Transition conditions exist, connecting all these various manifestations more or less closely with one another. They constitute, indeed, one great assemblage of related though apparently heterogeneous phenomena, which have mostly received separate consideration under their respective names. Though it is desirable that their fundamental relationship should have been thus briefly pointed out, no practical end would be achieved by dwelling further upon the group as a group, upon the physiological meaning or origin of the several forms of spasm, or on their therapeutic treatment, which will be found described under separate articles. *See* also Motility, Disorders of.

H. Charlton Bastian.

**SPASMODIC.**—Synon.: Fr. *Spasmodique*; Ger. *Krampfhaft*.—A descriptive epithet applied or applicable to conditions or diseases in which spasms, and mostly those of the tonic class, are met with as prominent or essential constituents; for example, *spasmodic croup*, *spasmodic asthma*, *spasmodic stricture*. *See* Spasm.

**SPECIFIC.**—When applied to a disease, the word specific signifies that such disease is produced by a special cause, and has special characters, for example, syphilis and the eruptive fevers When applied to a remedy, it implies that the substance has a distinct and definite effect in the cure of a certain disease, such as mercury in syphilis, or quinine in ague; or that it acts upon a particular organ, as ergot upon the uterus.

**SPECTACLES, Uses of.** *See* Vision, Disorders of; and Strabismus.

**SPECTROSCOPE IN MEDICINE.**—As one of the instruments of research in practical medicine the spectroscope is of quite recent introduction; and, as yet, it can hardly be said to have taken a place amongst those of general application. It has been of service to the physiological chemist, in the analysis of the tissues of the body; and for the detection of blood-stains, and perhaps of poisons, it promises to be of value to the practising physician. It is towards a more complete knowledge of the nature of animal and vegetable pigments that it would seem to be of most use.

Description.—The application of the instrument depends on the principle that all matter, in whatever condition—solid, liquid, or gaseous—possesses the property of absorbing certain of the rays of light by which it may be illuminated, and reflecting others. This being granted, if the spectrum be taken, that is, the series of component colours into which a light—whether sun, gas, paraffin, or electric—may be split up in its passage through a prism; and if there be introduced between the source of light and the prism the material to be investigated, there will be produced certain definite and characteristic modifications of the spectrum, in the form of dark bands of various intensity and position. Such are called *absorption-spectra*, and are those referred to here.

The mechanical arrangement required to attain this object consists of (*a*) a *glass prism*, so placed as to give a minimum deviation of the refracted rays; between which and the observer is (*b*) a small *telescope* through which the refracted rays pass to the eye; and on the distal side of the prism, between it and the source of light, is (*c*) a *tube*, carrying next to the prism a double-convex *lens*, and at the other extremity (*d*) a slit, the margins of which are constricted by accurately and movably adjusted knife-edges. The length of this tube, called the *collimator*, is equal to the focal length of the convex lens. The whole apparatus may be carried on a stand, so arranged that the telescope may move round the prism as a centre, and the angle it makes with the collimator recorded on a scale. A simpler instrument has been constructed by Browning, which can be carried in the pocket.

By an ingenious arrangement the instrument has been adapted to the microscope, forming the *microspectroscope*, and is then applicable to the examination of very minute quantities. But in this case there is no telescope, the spectrum formed by the prism being viewed directly.

Applications.—In the greater number of cases where the spectroscope is applicable to medicine, it is for the examination of fluids, although solids and morbid gases have also been investigated. For fluids it is sufficient to arrange the instrument

so that the spectrum of a gas or paraffin flame is obtained, and then to place a test-tube (a flat one is best) between the slit and the light. Some practice is required in adjusting the instrument, regulating the size of the slit, excluding extraneous light, and obtaining the most suitable degree of dilution and thickness of stratum of the fluid to be examined. The positions of the absorption-bands are most conveniently recorded by referring them to the standard Frauenhofer lines of the solar spectrum.

Certain precautions require to be borne in mind in regard to the absorption-spectra. Thus it appears that every substance has not its own spectrum, entirely distinct from that of any other, but that many bodies, very different in nature, possess the same spectrum, as carmine and oxyhæmoglobin; it is by the behaviour of the spectra, under the treatment of the fluids with reagents, that the spectroscopic results come to be of definite value. Again, the same substance may give different spectra according as it is in a solid, fluid, or gaseous state; or solutions of the same body in different media may give different absorption-bands.

1. **Blood.**—Hæmoglobin, both in the oxidised and reduced condition, is easily recognised by its spectrum. The former shows the dark lines in the yellow and green regions of the spectrum, the one next D being darker and more strongly marked than the other, which is near to *b*. Reduced hæmoglobin, on the other hand, gives but one dark band, in a position between the two of oxyhæmoglobin. The spectrum of blood is identical with that of hæmoglobin, of which $\frac{1}{1000}$ of a grain may be detected by the spectroscope; but 'there does not appear to be any probability of our being able to decide by this means whether the blood is or is not human' (Sorby).

Carbonic acid and many other gases, such as carbonic oxide, or coal-gas which contains seven per cent. of CO, nitrous oxide (NO), and sulphuretted hydrogen ($SH^2$), and the cyanides of hydrogen, potassium, &c., nitrite of amyl, iodine, &c., all possessing an affinity for hæmoglobin, show characteristic absorption-spectra; and investigation by the spectroscope of blood treated with these reagents, helps to explain the poisonous characters that most of these bodies possess, and show it to be chiefly due to their combining so closely with the hæmoglobin that the latter ceases to be an oxygen-carrier; whilst $CO^2$ is very loosely combined, and is easily separated by mere exposure of the reduced hæmoglobin to the air.

The various derivatives of hæmoglobin, such as hæmatin, both acid and alkaline, hæmatoidin, and hæmin, all give characteristic spectra, by which they may be recognised.

It is necessary to be acquainted with the spectra of these bodies, as well as of oxy- and reduced hæmoglobin, since in many of the situations in which blood is sought for—as in urine, vomit, fluid of cysts, and stains on clothes—it has undergone changes into one or other of these derivatives. Ammonium sulphide is the most convenient agent for reducing hæmoglobin; and in examining any fluid for this body, it should always be employed, since it is by the behaviour of hæmoglobin under its influence that it may be identified and distinguished from carmine.

In the investigation of blood-stains, their age, as well as the character of the material in which they are found, must be considered. Distilled water, glycerine, or dilute solution of ammonia or nitric acid may be used to dissolve out the stain, with the result of giving a solution of hæmoglobin or hæmatin, which may be enclosed in an ordinary microscopic cell and examined with the microspectroscope.

2. **Bile.**—It is said that fresh human bile yields no spectrum, but that when diluted, or if hydrochloric or nitric acid be added, an absorption-band appears at F, which is due to a pigment known as urobilin. This spectrum may be regarded as a test for bile.

3. **Urine.**— Healthy urine gives a spectrum with an absorption-band at F, identical with that of urobilin, which behaves on treatment with reagents in the same manner as the spectrum of that pigment, and hence it may be regarded as a normal colouring matter of the urine, and absent in some diseases. Other pigments appear, from the spectra given, to be present in certain diseased states and in pregnancy. Sugar and albumen are not to be detected in the urine by the spectroscope.

4. **Fæces.**—On spectroscopic examination the band of urobilin is presented.

See *The Spectroscope in Medicine*, by Dr. MacMunn, and Dr. Thudichum's researches in the *Reports of the Medical Officer of the Privy Council*.

W. H. Allchin.

**SPECULUM** (Lat.) – Synon: Fr. *Speculum*; *Miroir*; Ger: *Speculum*; *Spiegel*.

Definition.—An instrument adapted for exploring the several channels and deeper-seated parts of the human body. The chief of these are the ear, the eye, the nose, the mouth, the throat, the rectum, and the vagina. For each of these there are specially adapted instruments.

Description.—Specula are made of various materials, and in a variety of shapes. The speculum is intended not only to permit and facilitate inspection, but also to dilate the canals and to expose parts, in order that they may be treated surgically, or have medicaments applied to them. For this reason a cylindrical speculum will not always answer the purpose; we have, therefore, bivalve and trivalve specula, and many other forms. On account of the friability of glass, other material has not infrequently to be used, such as white polished metal or wood; the latter is objectionable, as it has no reflecting power; but when it becomes necessary to apply the actual cautery through a speculum, a substance must be employed that is a non-conductor of heat and non-friable, such as wood.

Varieties.—**Aural specula.**—Of these there are several forms, and some are known under the name of 'auriscopes.' Some have a trumpet-shaped opening, which facilitates the introduction of light, and greatly increases the illuminating and reflecting power. There are also bivalve aural specula with a screw lever, and others with handles attached so as to separate the blades.

**Eye specula.**—These are known by the name of *eyelid retractors* and *ophthalmoscopes*, both of which are really specula for examining the eye, though not generally classified as such. *See* Ophthalmoscope.

**Nasal specula.**—There are several of these, the great purpose they have to serve being that of dilating. One, known as Elsberg's, is three-bladed.

**Throat specula.**—Specula for examination of the throat are generally called *laryngoscopes*. *See* Laryngoscope.

**Rectal specula.**—These are cylindrical, bivalve, or trivalve. The cylindrical are made on the principle of Fergusson's vaginal speculum, but with an opening so as to expose the wall of the rectum at whatever part it be adapted to. The valvular forms are made of white metal.

**Vaginal specula.**—Of these there are many. Perhaps the most useful is that known as Fergusson's, which is cylindrical and made of glass, with a coating of mercury behind it, so as to give it reflecting power, and backed by vulcanized india-rubber. An improved variety of this is of a tapering form, so as to admit more light. *See* Womb, Diseases of.

Sims' duck-bill speculum is of great use in retracting the perinæum and dilating the vagina, when space is required for operation, as in vesico-vaginal fistula. Then there are bivalve and trivalve metallic specula. Wooden cylindrical specula are always used when the actual cautery is applied, for reasons already mentioned. For the ordinary purposes glass is the preferable material, as it is unaffected by caustics.

The uses of specula will be found described in connexion with the diseases of the several organs to which they have reference.

Clement Godson.

**SPEECH, Disorders of.**—Synon.: *Troubles du Langage*; Ger. *Stöhrungen der Sprache.*—Defects of speech are very various in their nature, degree, and mode of causation. They are capable of being classified from several different points of view. We shall not attempt to do more in the present article than point out the nature and relations of the several kinds of defects, which will, in almost all cases, be found to have received consideration under their own proper headings.

Ætiology and Pathology.—Disorders of speech may depend upon (1) *congenital*, or (2) *acquired* defects of the brain, or of certain of its nerves and sense-organs.

1. *Congenital defects.*—The most frequent and important of these defects is *deafness*, which entails mutism, so that the individuals thus afflicted are known as 'deaf-mutes.' It must, however, be borne in mind that this condition of mutism or dumbness may also be brought about by absolute deafness occurring from any cause after birth, but before the child begins to talk; or even after it has learned to talk, up to the fifth or seventh year. In cases of the latter type, the child soon, when without the accustomed guidance derived through the sense of hearing, forgets how to speak and becomes dumb. In addition to this class of cases, there are those of congenital idiocy without deafness, but in which the child never learns to talk or articulate in the proper sense of the term (*see* Idiocy). There are also other cases allied to the last, in which, owing to some intra-cranial lesion occurring either before, during, or soon after birth, the child's subsequent mental condition is greatly impaired, as well as its motor power. In these most deplorable cases the child may never be able to speak in any distinct or articulate fashion, it may not be able to walk or even stand, or it may only be able to accomplish these latter acts imperfectly. In some of these children there is evidence of the existence of a hemiplegic condition, with arrest of growth of the paralysed limbs. Such patients are also frequently subject to one-sided fits; but it is not certain whether in these cases the inability to speak is especially prone to occur in those who are congenitally paralysed on the right side. In some of the less severe examples of this latter type which have come under the writer's observation, speech has been merely deferred—the child has not commenced to speak till the fourth, fifth, or even the sixth year. *See* Dumbness.

2. *Acquired defects.*—Among acquired defects of speech we have troubles of various degrees and kinds, which may come on at any period between infancy and old age, and which, as regards duration, may be temporary or permanent. The great variations in the extent and nature of these defects is due to the fact that the impeding condition or lesion may act (1) upon parts of the brain concerned with the genesis of thought, and of the will to speak, (2) upon some part of the nervous channels or centres concerned with the actuation of speech, or (3) upon the peripheral nerves and organs concerned with articulation and vocalisation. Thus it happens that acquired defects of speech may, in one set of cases, be associated with the most marked alterations in the intelligence or previous mental condition of the patient, whilst in others they may be represented by mere defective articulation or vocalisation. In briefly referring to the principal varieties, we will pass from the simple to the more complex types.

Proper vocalisation is essential for the production of normal speech; where it alone is defective we have to do with various kinds of aphonia, which may be due to very different causes (*see* Voice, Disorders of). Again, articulation as a mere motor act may be interfered with or perverted in diverse modes. Where speech-movements are incoördinate, we have such common defects as stuttering or stammering (*see* Stammering); or else those less marked perversions of speech-movements which are met with in some cases of chorea. Again, where the movements concerned in speech are more simply defective, we have that indistinctness of articulation and blurred utterance which, in various degrees, is so commonly associated with different forms of paralysis due to cerebral disease. To this kind of defect the name 'Aphemia' is now commonly applied. It presents itself under many various conditions, and with different degrees of completeness. It may show itself in its most extreme form in 'labio-glosso-laryngeal paralysis.'

or in other forms of bulbar disease. This blurred or difficult articulation is also one of the signs met with in general paralysis of the insane and in disseminated cerebro-spinal sclerosis. Again, it occurs in association with hemiplegia caused by different lesions in various parts of the brain, between the medulla below and the cerebral cortex above. As a rule it is most marked and most persistent in hemiplegia due to disease of the pons Varolii, while in lesions higher up it is apt to be slight and more transitory, especially where such lesions exist on the right side of the brain. It is evident, indeed, that this kind of defect is specially prone to occur where there is damage to the first parts of the outgoing tract leading from the left cortical auditory word-centre, or to any lower parts of the same tract, or when there is damage to the actual motor centres for articulation situated in the medulla oblongata (see *Brain as an Organ of Mind*, 1880, p. 618). Damage to the upper part of these tracts, however, so long as it is situated above the level of the left corpus striatum, gives rise to a form of this aphemic defect which is commonly known as *aphasia* (*see* APHASIA). The writer's most recent investigations have led him to the conclusion that this condition may, in reality, and in full accordance with modern doctrines as to the strict localisation of cerebral functions, be induced by damage in parts of the cortex comparatively remote from the 'third frontal convolution' (*op. cit.* p. 685). Such forms of speech-defect may exist without obvious mental impairment, and it is worthy of note that they may sometimes be induced without coincident hemiplegia, by over-work, either literary or clerical, or under the influence of great excitement. Related to speech-disorders of this type are the other more complex and extremely varied defects of speech classed under the head of *amnesia*. These are often associated with grave mental and volitional defects. The writer has recently come to the conclusion that they are especially apt to occur in association with lesions involving the supra-marginal lobule, the angular gyrus, and the posterior part of the upper temporal convolution, that is to say, the convolutions which bound the upper end of the 'Sylvian fissure' (*op. cit.* p. 683). These are parts of the cortex which, according to Ferrier, have much to do with visual and auditory impressions. They would accordingly be concerned with the appreciation, on the one hand, of printed and written characters, and, on the other, of spoken words; and seeing that such parts of the cortex must also afford the starting-points for volitional incitations to acts of writing, reading, and speaking, it can easily be understood how much damage to the brain in these regions may interfere with intellectual 'appreciation,' as well as with intellectual 'expression.'

Finally, in this relation, reference should be made to certain forms of speechlessness occasionally met with in hysterical females, or in the insane of both sexes, in which there may be a deficiency of will to speak, dependent upon perverted cerebral action, either without or with a discoverable basis of actual morbid changes. In such cases, also, there may be no apparent motive · or the speechless condition may, in the insane, stand in direct or indirect relation to certain delusions.

TREATMENT.—The treatment of these various defects of speech will, of course, depend upon their causes and associated conditions. Reference must, therefore, be made to the several special articles in which the different forms of such defects are considered.

H. CHARLTON BASTIAN.

**SPERMATORRHŒA** (*σπέρμα*, seed, and *ῥέω*, I flow).—SYNON.: Fr. *Spermatorrhée*; Ger. *Samenfluss*.

DEFINITION.—A real or apparent discharge of seminal fluid, occurring without voluntary sexual excitement.

Two varieties may be recognised. (1) *True spermatorrhœa* is the discharge of spermatozoa from the urethra, or in the urine, at periods other than during sexual excitement. (2) *False spermatorrhœa*, or *prostatorrhœa*, is the discharge of a seminal-like fluid, destitute of spermatozoa.

ÆTIOLOGY.—Local irritation, whether from masturbation or from some diseased or disordered condition of the genital organs, is the cause of spermatorrhœa in the first instance. Such morbid conditions are balanitis, phymosis, a long prepuce, urethral catarrh, irritability of the prostate, a tender spot in the urethra, spasmodic contraction of the levator ani, varicocele, rectal irritation, worms in the intestinal canal, constipation, and changes in the nerves or nerve-centres supplying the genito-urinary tract, inducing either hyperæsthesia or anæsthesia. Any of these states may give rise to masturbation, or masturbation may in turn cause most of them. Should the conditions that determine the irritation persist, the very smallest mental or local stimulus is sufficient to continue the disease indefinitely.

SYMPTOMS.—The first symptom that alarms the subject of spermatorrhœa is the occurrence of frequent nocturnal emissions, at first with, and afterwards without, erotic sensation. These reduce his strength, render him weak and irritable, and gradually prey upon his mind; and if, as frequently happens, masturbation be practised, they induce a condition of extreme mental depression. When the patient reaches this state, the mere reference to sexual matters, the sight of anything lewd, the act of defæcation, or a chance irritation of the penis during walking, riding, or driving, is often sufficient to cause an abortive or, it may be, a complete emission. The discharge may, in advanced cases, find its way into the bladder and be passed with the urine; a condition which is regarded by the patient as the most serious of all. The discharge may be the ordinary seminal fluid; or it may be less in quantity, clearer, tenacious, more like the synovial fluid in appearance and consistence. In the latter case it seldom contains spermatozoa, and it is usually only the forerunner of the other more serious state, or it may intermit with it. These conditions combine to render the patient for the time being physically and mentally a wreck, sleepless, listless, nervous, anæmic, and with an old and insipidly anxious look upon his muddy or pimpled face. Connection becomes well-nigh impracticable, the discharge of semen

occurring before the introduction of the organ; or erection may be impossible or imperfect.

Diagnosis.—In the diagnosis of the cause of spermatorrhœa, the condition of the external genitals must first be determined. The presence of a tender spot in the urethra, or the existence of hyperæsthesia or anæsthesia or stricture, can be made out by passing a catheter. The acorn-pointed bougie is the best for diagnosing the exact seat of such troubles. The discharge itself must be found and examined microscopically, the presence of spermatozoa establishing true spermatorrhœa. Glairy fluids, like that of prostatorrhœa, occur in the urethra during the last stages of a gleet, or in straining at stool, and also in stricture. The history of the case, and catheterism, readily clear up the cause of the discharge.

Prognosis.—In the generality of instances the patient gets quite well, either by ordinary care on his own part, or by medical treatment. In other cases, however, the development of some inherited disease manifests itself simply from the weak condition to which the patient is reduced. In some instances dementia or melancholia is induced, and the patient continues his impure habits even whilst under watch and ward in a lunatic asylum.

Treatment.—Should any local irritation appear sufficient to cause spermatorrhœa, it ought to be treated and removed, if possible. A long prepuce should be cut off, balanitis cured, a varicocele relieved, or rectal irritation removed. To prevent masturbation many plans have been tried, such as the application of iodine to the penis, or touching the parts with caustics, which, by the pain they cause, prevent the patient meddling with the organ. These measures, or such as these, combined with encouragement from the medical attendant, and resolution on the part of the patient, will help towards a cure. The situation of a tender spot in the urethra can be made out, either by a bougie—the acorn-pointed bougie, as above mentioned, being the best for such a purpose—or by pressure on the perineum. When discovered, the tenderness may be relieved by blisters on the perineum, or by applying caustics directly to the tender surface, either in substance or in solution. The solution chiefly used is one of nitrate of silver, varying in strength from ten to sixty grains to the ounce, and it is best applied by the silver syringe-catheter. The patient's digestion, and impaired physical and mental condition must be looked after. Stomachic and nervine tonics, such as gentian, strychnia, phosphates, and iron, are the most useful, and must be given for some time. To allay irritability of the genital organs, the bromides and belladonna may be given separately or in combination. For hyperæsthesia the extract of belladonna, in half-grain doses morning and evening, is especially useful; it may be given with the tonics recommended above. Should anæsthesia of the urethra and genitals exist, galvanism has been tried and proved successful. The patient should sleep on a hard bed, and get up the moment he wakes. Cold hip-baths morning and evening, walking exercise, and mixing in company as much as possible, are useful adjuvants to treatment. *See* Masturbation.

James Cantlie.



**SPEZIA, Bay of, in Central Italy.**—A calm, moist, moderately warm, equable, winter climate. Prevailing winds, S. and E. *See* Climate, Treatment of Disease by.

**SPHACELUS** (*σφάζω*, I destroy).—The process of mortification, or the dead mass resulting from this process. *See* Gangrene.

**SPHINCTERS, Disorders of.**—Synon.: Fr. *Troubles des Sphincters*; Ger. *Stöhrungen der Schliessmuskeln.*

From a practical point of view, it is here only needful to refer to disordered actions of the sphincters of the bladder and of the rectum. The disorders themselves are in each case of two kinds. We may have to do with *spasm* of the sphincter vesicæ or of the sphincter ani, leading to or, at least, aiding in bringing about, retention of urine and retention of fæces respectively; or, on the other hand, there may be *paralysis* of these sphincters, leading to incontinence of urine, and favouring incontinence of fæces.

Ætiology and Pathology.—These opposite modes of disordered function of the sphincters of the bladder and the rectum may be variously induced; but the causes may be ranged in three principal categories, according as they are—(1) of *peripheral* or *reflex*, (2) of *spinal*, or (3) of *cerebral* origin.

(1) *Reflex causes.*—These are not always distinct from those of the next category, and they more frequently reveal themselves as spasms than as paralyses. Retention of urine due to reflex spasm of the sphincter of the bladder is frequent enough, especially in stricture of the urethra or stone in the bladder. On the other hand, a weak action of the sphincter, with undue irritability of the bladder, may lead to nocturnal incontinence of urine in children. Temporary paralysis of both sphincters may occasionally be induced by a kind of cerebral reflex, under the influence of fright. Spasmodic conditions of the sphincter ani may be induced by the irritation of fissures or small ulcers just within the anus, and may tend greatly to increase the suffering of the patient during or after defæcation.

(2) *Spinal causes.*—The majority of the cases of disordered action of the sphincters will be due to this class of causes. They are incidents of functional or of structural diseases of the spinal cord, or of the nerves by which such sphincters are supplied. Here, too, we may have irritation of the spinal centres or of their nerves, causing spasms and corresponding retention of urine or of fæces; or we may have pressure upon or destructive lesions of the same parts, in and issuing from the lower lumbar region of the cord, leading to paralysis of the sphincters, and a corresponding incontinence of urine or of fæces. Irritation or destruction of the channels in the cord, by which voluntary incitations are conducted to these sacral centres, may also lead to spasm or paralysis of either of the sphincters (*see* Spinal Cord, Diseases of, § 9, 7, 8). In many structural diseases of the cord entailing paraplegia, paralysis of the sphincters (owing to its different sequelæ) becomes an important condition, which notably influences the gravity of the dis-

ease, and demands the exercise of great care in counteracting its effects, as far as this may be possible. *See* SPINAL CORD, Softening of.

(3) *Cerebral causes.*—In cerebral disease, where the mind or consciousness is profoundly affected, there may be incontinence of fæces or of urine. Yet such events can scarcely be said to be due to a disordered action of the sphincters. If no restraining or inhibitive power be exercised by the cerebral hemispheres, then the spinal reflex mechanisms regulating the action of the detrusor muscles and of their related sphincters are called into play from time to time. The latter become relaxed coincidently with the contraction of the expulsor muscles of the bladder or rectum, when, from either viscus, a sufficiently powerful set of afferent impressions passes to the related spinal centre. So that in hemiplegia with mental impairment, in dementia, or in stupor or coma, we commonly meet with incontinence of urine and of fæces. Over-action or spasm of these sphincter muscles may also occur under various perverted cerebral conditions, especially in hysteria; thus occasioning an undue retention of the contents of the bladder or of the rectum, as the case may be.

The sphincter of the vagina is also liable to be affected by spasm, but this subject is considered in another part of this work. *See* VAGINA, Diseases of.

TREATMENT.—The treatment of disorders of the sphincters must of course depend upon the nature of the cause, and upon the nature of the particular defect existing in each individual case. When the exciting cause is local, it must be remedied if possible. Where due to structural disease in the spinal cord or in the brain, the above disorders present themselves among many other morbid signs and symptoms, and in these cases we must always strive to correct, as far as it may be possible, the original and common cause of the morbid symptoms in question.

H. CHARLTON BASTIAN.

**SPHYGMOGRAPH, The** (*σφυγμὸς*, the pulse, and *γράφω*, I write).

DEFINITION.—The pulse-writer; an instrument devised to record the form of the movements of the arterial pulse.

HISTORY.—The idea of this instrument is as old as Galileo, but it is only in recent years that it has assumed a practical form. The first registering instrument, for recording the movements of an artery, was used by Ludwig in 1847, ten years after Hérisson had devised his sphygmometer, by which he showed in a column of fluid the movements of the pulse. It was with this instrument that Chelius demonstrated the second wave, or dicrotism of the normal pulse.

Vierordt was the first to construct a sphygmograph which could be applied on man, utilising an idea of King's, who had previously demonstrated the pulsation of the veins in the neck by attaching to them a delicate lever. The instrument of Vierordt, however, did not record the form of the pulse-movements accurately, and for the most part registered only a series of uniform curves. This physiologist remarked that the problem was to place on the pulse a very delicate elastic spring, and by means of it to transmit the movements of the pulse to the writing lever. Marey succeeded in doing this by the invention of his sphygmograph, which became, after the publication of his work in 1863, forthwith applicable for clinical, as well as physiological, research. Its introduction gave the study of the pulse a scientific basis, by causing the arteries to write their autographs, and thereby restored to its first importance the neglected art of reading the pulse.

DESCRIPTION.—Although there are now several sphygmographs at work in the field of clinical inquiry, it will be necessary to describe only that of Marey, which is most commonly in use.

The essential part of the instrument is a delicate spring, armed at its free end with an ivory pad which rests upon the artery. The spring is fixed by its other extremity to the framework, and receives the pulse-movements, which are transmitted, amplified, and recorded by an arrangement of two levers. The lower lever is hinged to the steel spring, so that it can move up and down at its free end, which terminates in a vertical knife-edge considerably above the ivory pad, which rests on the artery. This knife-edge can be raised or lowered by means of a screw, and so adjusted and maintained in contact with the upper lever, near its centre of motion. This second or upper lever, which points in the opposite direction to the lower one, is very light, and carries at its free end a pen, which records, on a plate moved by clockwork, the vertical movements transmitted to it through the first lever, from the spring resting on the artery. By this arrangement of levers the movements originally received by the spring from the artery are amplified some fifty times in the record.

The tracing is called a *pulse-trace*, and consists of a series of pulsations, varying in number and form according to the frequency and the characters of the pulse. *See* PULSE.

The frame of the instrument, to which the spring is fixed, holds the clockwork by means of which the recording plate is made to travel.

The framework is also made so as to fit easily on the arm, and is retained in position by straps, the arm resting on a suitable pad or cushion.

The regulation of the pressure of the spring on the artery is one of the most important points in the application of the instrument. It requires to be accurately regulated and measured, in order to estimate the character of the pulse, and render a comparison of traces trustworthy, as was first pointed out by the writer. This is effected by a regulator screw connected with the steel spring, and furnished with a registering dial, which records the pressure at which the maximum rendering of the pulse is obtained. By this arrangement the tension of the pulse can be fairly estimated by the sphygmograph.

APPLICATION.—In the application of the instrument, the first important point to observe is accuracy of adjustment of the ivory pad of the spring over the radial artery. This can be best done by marking the position of the artery with ink, and then carefully adjusting the spring. Secondly, the pressure on the artery must be regulated by means of the pressure screw, so as to obtain the greatest amplitude

of movement by the lever, and the record of all the waves of the pulse. Thirdly, the friction between the recording pen and the receiving plate, on which the trace is recorded, must be reduced to a minimum. Smoked glass and paper are the best receivers; pens that write with ink are apt to blur the finer features of the trace. The tracings on smoked glass or paper are fixed and rendered permanent by varnish; the tracing papers, which should be well enamelled, may be smoked by being held over burning paraffin or camphor, or even over an ordinary vesta match. When the traces are recorded, they may be fixed by varnish made of gum benzoin, or Burgundy pitch in methylated spirit (1 in 8), or ordinary tincture of tolu.

Uses.—The applications of the sphygmograph to clinical inquiry are numerous and important. Precision is given to the study of the pulse, and by the aid of a graphic representation of its form the finger is taught what to feel. A pulse-trace (*see* Pulse) shows at a glance the rate, regularity, and equality of the heart-beats. Irregularities, and especially inequalities, that escape the finger, are registered; and indications as to pulse-tension and heart-strength, most important for prognosis and treatment, are obtained. In acute visceral inflammations, for instance, slight inequalities in the pulsations otherwise unrecognisable may be recorded, and the first signs of heart-failure, and the necessity for stimulants thus suggested. Again, the undulatory pulse of a ventricle, too weak to resist respiratory influences, is disclosed in the tracing; and prognosis and treatment may be correspondingly modified.

Indications. — The evidence yielded by the Sphygmograph mainly concerns :—1. the mode of the heart's contraction; 2. the condition of the peripheral circulation; 3. the state of the arteries and their coats; and 4. valvular diseases of the heart.

1. **The mode of the heart's contraction.**—The sphygmographic tracing shows this by the line of ascent. When the heart-muscle acts suddenly and vigorously, the line is vertical and lofty, and terminates in a pointed summit-wave. Unless the vessels are over-full of blood, there follow well-marked tidal and dicrotic waves. On the other hand, when the heart's contraction is feeble, the line of ascent is less vertical and lofty; the summit wave is less distinct; and the tidal and dicrotic waves are less, or the former is blended with the summit wave. The pulse, moreover, unlike the pulse of a vigorous ventricle, is easily obliterated by pressure. A note of the pressure at which the most perfect trace is collected should always be made, as it enables the observer to compare results at different times.

2. **The condition of the peripheral circulation.**—The easy or difficult passage of the blood through the arterioles and capillaries, causing low or high pulse tension, is estimated by the pressure required to develop or to obliterate the three waves, but more especially the tidal and dicrotic waves. Obstructed peripheral circulation is manifested by increase of the tidal wave, diminution of dicrotism, and lessened height of line of ascent and summit wave (fig. 74). The heart, apart from febrile or nervous excitement, contracts less suddenly under these conditions. On the other hand, in easy and quick capillary circulation, such as occurs in fevers, the sudden heart-contraction increases the height of the line

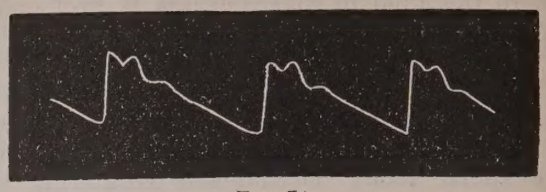

Fig. 74.

of ascent, exaggerates the summit wave, lessens the tidal wave, and fully develops the dicrotic wave (fig. 75). In such conditions the fully

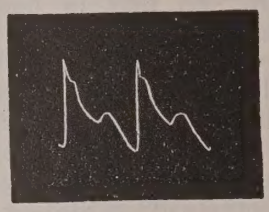

Fig. 75.

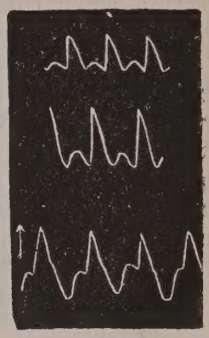

Fig. 76.

dicrotous and hyperdicrotous traces are recorded (fig. 76). The rapid onflow of blood is, moreover, shown by the more sudden fall of the line of descent. It is by the comparative study of the three waves, and the pressure required to record them fully, that we obtain valuable indications as to heart-strength and pulse-tension in acute diseases, and in the earliest stages of some chronic affections.

3. **The state of the arteries.**—There are three chief conditions of the arteries that modify the pulse:—(*a*) the state of the *muscular* coat; (*b*) *degenerative* conditions of the arterial walls; and (*c*) the presence of *aneurism*.

(*a*) When the *muscular* coat is contracted, the artery imparts to the finger a hard, wiry sensation, which shows in the trace by a short line of ascent, and the blending of the summit and tidal waves in an oblique line of descent, scarcely broken by dicrotism (fig. 77). In the opposite condition of relaxed arterial coats, the dicrotic and summit waves are enlarged, and the tidal waves lessened. These changes can be experimentally illustrated by the application of cold and heat to the surface of the body. The cold and hot stages of ague also show the two states.

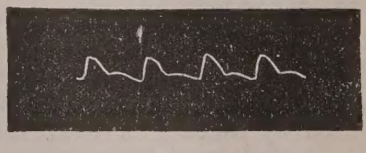

Fig. 77.

(*b*) *Inflammatory* and *degenerative* processes

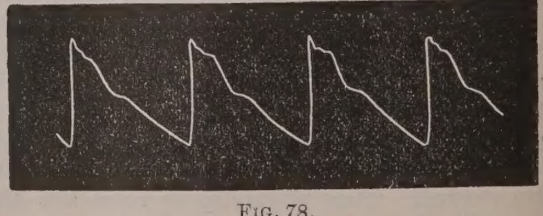

Fig. 78.

lead to rigidity of the arteries, whereby the modi-

fying influence of their elasticity on the blood-movement is lost. The blood-wave in the radial artery consequently approaches more to that imparted by the heart's systole. In these conditions the pulse often beats visibly, so that we are prepared for the amplitude of the trace. The tidal wave is large, nearer to, and often blended with the summit wave, while the dicrotism which occurs early in the line of descent is badly marked. The presence of these peculiarities often leads to the early diagnosis of unsuspected atheroma of the great vessels (fig. 78).

(*c*) When the sac of an *aneurism* is seated on a main trunk after its origin from the aorta, it acts as an elastic bag, and so modifies the pulse-form by rendering the line of ascent oblique, diminishing or abolishing the summit wave, modifying the dicrotism, and more or less connecting the three waves into a simple curve. To the finger these changes mean retardation (oblique line of ascent), and diminution of force (loss of summit wave). Such peculiarities in the left radial artery are produced by an aneurism of the left subclavian, or in the right radial by innominate aneurism. When the aneurism is connected with the thoracic aorta in its ascending portion, there is frequently a dissimilarity between the two radial pulse-traces, which is persistent, one being smaller than the other, more vibratory, or more easily obliterated by increased pressure. The pulse usually more affected is the right, as the aneurism tends to implicate the innominate artery. In aneurism of the transverse portion of the arch, the left pulse is more commonly diminished in force and amplitude (figs. 79 and 80). In aneurisms

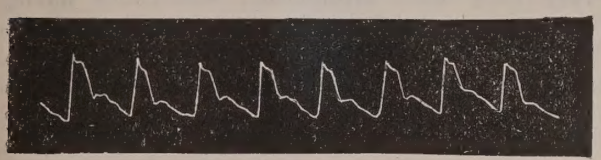

Fig. 79. Right Radial Tracing.

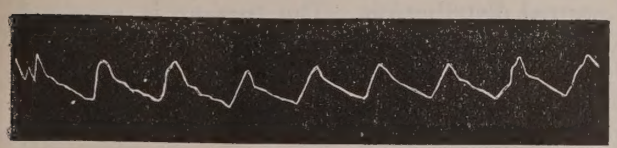

Fig. 80. Left Radial Tracing.

of the descending thoracic and abdominal aorta, the dicrotic wave is often much i creased in both pulses, while the right radial yields usually the more normally developed trace.

These signs may be more or less simulated by pressure of tumours on the arterial trunks, or by their partial obstruction by clots. The sphygmographic signs of aneurism, therefore, require to be confirmed by the use of the ordinary means of diagnosis. In some cases, however, the pulse-traces alone suffice to indicate the lesion and its seat.

4. **Valvular diseases of the heart.**—Valvular diseases of the heart generally influence the pulse-trace. In *aortic regurgitation* this is strikingly seen (fig. 81). The strong, dilated ventricle contracts suddenly on a large charge of blood, and consequently there is a lofty line of ascent, ending in a pointed summit-wave. The tidal wave is small in proportion to the trace; and the dicrotism, which occurs later than normal in the line of descent, is generally much diminished, on account of the leakage into the ventricle interfering with the rebound of the blood-column from the closed valves. The dicrotic wave, thus starved, is followed by a rapid fall in the tracing, showing the quick emptying of the artery. It is this contrast between the height of the summit wave and the rapid fall of the trace, unbroken by any *sustaining* wave, that gives the pulse its splashing and collapsing character. These features, the small dicrotism and the rapid fall, indicate the amount of regurgitation. In some cases of this valve-lesion the tracing shows a well-marked tidal, and a fairly-developed dicrotic wave; and increased pressure by the spring of the sphygmograph, instead of obliterating the trace as usual, shows that there is a fair amount of tension. Such features commonly occur in older persons, in whom the valve-defect is due to atheroma, and not to rheumatism, and the pulse-form is modified by the addition of the characters of the pulse of degenerated arteries. When such features are observed in rheumatic cases, they point to perfect compensation and small valve-defect.

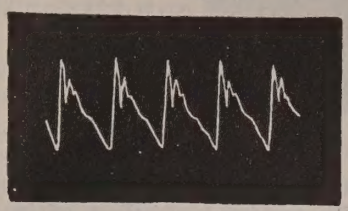

Fig. 81.

In *aortic stenosis* the trace testifies to the amount of the lesion. When the narrowing is extreme the summit wave is lost, the line of ascent becomes oblique and gradual, and the pulse is felt to be retarded. More commonly a break in the line of ascent marks the position of the summit wave, while above it rises the large tidal wave, due to the strong systole (fig. 82). In cases in which the obstruction is less in degree, the summit of the tracing may be forked by a sharp division between the summit and tidal waves. The dicrotic wave is lessened. The loss or checked development of the summit wave, followed by an exaggerated tidal wave, arising from a strong and often dilated ventricle, pushing a large blood-wave *gradually* into the arteries through the narrowed aortic orifice, are the characteristics of this lesion when pure. When it is associated with aortic regurgitation, the large tidal wave is still pronounced.

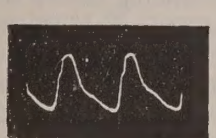

Fig. 82.

*Mitral valve* lesions, which are less immediately connected with the arterial blood-movement, present less decided characteristics.

In *mitral regurgitation* the tracing is often of the normal outline, and in such cases the compensation is fairly perfect. In some cases, in addition to great rapidity, the pulse is small and shabby, in striking contrast to the vigour of the impulse (fig. 83). The line of ascent is sloping, and the tidal and dicrotic waves poorly defined. In other cases, great irregularity is the chief feature of the trace, a series of small, ill-developed pulse-waves being succeeded by large and well-formed

pulsations. On analysis, the series of small, ineffectual heart-contractions correspond to inspiration, and the fuller and more vigorous ones to the respiratory pause. In other conditions similar irregularities are caused by the same influences. Burdon Sanderson, who first referred these irregularities to their cause, says: 'The mechanical effect of inspiration is to augment the quantity of blood contained in the pulmonary circulation, and hence to increase the frequency of the contractions of the heart. This increased frequency depends on the distended state of the auricles, in consequence of which the ventricles fill more rapidly during their period of relaxation. In this way the length of the diastolic pause is diminished, and the hurried action of the heart satisfactorily accounted for; but the question still arises, Why are the rapid beats which occur in inspiration also ineffectual? Very probably because the mitral valve does not close; the heart being distended with blood, its walls are kept apart to such an extent that the curtains do not meet. The ventricle contracts, but much of its blood is discharged into the auricle, to be returned to the ventricle as soon as its contraction is over. It is not until the effect of inspiration in keeping the auricles full ceases, that the curtains get near enough to allow the heart to make an effort sufficiently effectual to send a full tide of blood into the aorta, and thus relieve the distended pulmonary circulation.'

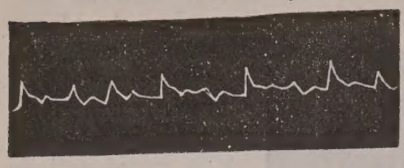

FIG. 83.

Similar peculiarities are occasioned by the same mechanism in tricuspid regurgitation and dilated heart.

In *mitral stenosis* the sphygmographic evidence is very important. The pulse-tracing shows irregularity in the line of descent, which often is greatly prolonged through a missed pulsation—a true intermission in the beat, and sometimes broken by the interpolation of a small, abortive pulsation (fig. 84). These abortive pulsations

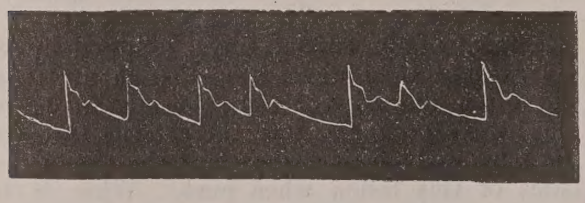

FIG. 84.

are due to over-distension of the auricle, causing premature auricular contractions, which propagate themselves to the ventricle, and so produce a ventricular contraction on a small charge of blood. They mostly occur during inspiration, from the causes above described. The rhythmical relations between the contractions of the auricle and the ventricle are thus disturbed, and hence the features above described.

These are the special characters of the pulse of mitral stenosis. In some cases where the stenosis is not great and the compensation perfect, the pulse is regular in time and form, or nearly so; but in these cases characteristic irregularities can often be produced by vigorous exertion.

Finally, in therapeutical investigations the sphygmograph is indispensable as a means of discovering the influence exerted by a drug on the state of the vessels, on the condition of the peripheral circulation, and on the vigour of the heart. The modifications in the form of the pulse-trace above described enable the investigator to estimate these effects.

BALTHAZAR FOSTER.

**SPINA BIFIDA** (*spina*, the spine, and *bifida*, cleft).—SYNON.: Fr. *Hydrorhachis congénitale*; Ger. *Rückenspalte*.

DEFINITION.—A congenital malformation, with arrest of development, of some portion of the spinal column.

Generally there is a deficiency of two or three spinous processes and the laminæ; the rudimentary portions of the arches of the vertebræ being spread out and irregularly expanded. The spinal cord being thus left unprotected, its membranes protrude through the aperture posteriorly, forming a kind of hernial tumour.

ANATOMICAL AND CLINICAL CHARACTERS.—At birth the tumour in spina bifida is generally about as large as a walnut, and either spherical or oval in form. It may be met with in any part of the spinal column, but with rare exceptions it occurs in the lumbar or lumbo-sacral region. The tumour is filled with cerebro-spinal fluid, and is therefore always tense, with distinct fluctuation; its tension increases when the child cries, and may be diminished by pressure. The cutaneous covering of the tumour is generally very thin and attenuated, sometimes having the appearance of a transparent membrane, of a bluish or congested colour. In other cases the skin is of its normal thickness and colour. The nerve-trunks, forming the cauda equina, frequently traverse the interior of the sac in the median line, and after being reflected from the posterior wall of the sac, recross its cavity towards their normal distribution. The tumour is nearly always solitary, but cases in which a second tumour existed have been recorded.

DIAGNOSIS.—Difficulty in the diagnosis of spina bifida can hardly ever occur, and the characters above described will readily distinguish it from congenital tumours of a fatty, fibrous, or cystic character occasionally met with.

COMPLICATIONS.—Spina bifida is sometimes associated with hydrocephalus, with club-foot, or, it is said, with some paralytic symptoms; the latter complication probably occurring only in those cases in which the nerves of the cauda equina traverse the sac of the tumour.

COURSE AND TERMINATIONS.—The majority of cases of spina bifida terminate fatally, often within a few days or weeks of birth; the children dying from convulsions, frequently preceded by rupture of the sac, and the escape of its contents. When the fluid only oozes gradually, relief follows; and sometimes spontaneous and complete cure thus occurs, the tumour contracting to a small nodule, and the aperture in the canal closing more or less completely. In some cases, when the cutaneous covering is thick and normal, the tumour may gradually increase

in size without material inconvenience, up to the adult period of life, attaining the size of a child's head, or even larger dimensions.

Prognosis.—This must generally be unfavourable, especially when the tumour is of large size at birth, and its covering only thin, membranous, and vascular, with a broad base. When the base of the tumour is narrow, and its cutaneous covering thick and normal, the prognosis may be more favourable, especially if the malformation be situated on the sacrum.

Treatment.—The result of any treatment of spina bifida must be extremely doubtful, but in many cases the process of spontaneous cure has been successfully imitated by small tappings frequently repeated, and followed by light compression, covering the tumour with cotton wool or lint, and strips of plaster, Only a portion of the fluid should be allowed to escape at the time of operation; and the puncture should always be made at the side of the tumour, so as to avoid any possible injury to the nerve-trunks which may traverse the sac. Cases have been successfully treated by the injection of small quantities of iodine. Dr. J. Morton, of Glasgow, has used a solution made by dissolving 10 grains of iodine and 30 grains of iodide of potassium in an ounce of glycerine—half a drachm of which solution may be injected, without allowing the fluid contents of the tumour to escape, at intervals of a week or ten days. The writer has seen a case successfully treated in this way by Dr. Murray at the Great Northern Hospital. Other operative measures, such as compression of the neck of the tumour by means of a clamp or ligature, and also excision, have been employed, occasionally with success; but no such attempt should be made except under the most favourable circumstances, when the tumour has a very narrow base—more or less pedunculated, and is situated over the sacrum; otherwise death from convulsions or meningitis would probably follow any such attempts.

W. Adams.

**SPINAL ACCESSORY NERVE, Diseases of.**—The upper fibres of the spinal accessory nerve emerge from the surface of the medulla oblongata, below the pneumogastric. They arise from a column of nerve-cells adjacent to the nucleus of the hypoglossal, and continuous with the nucleus of the pneumogastric. The fibres join the latter nerve and innervate the movements of the larynx. Their share in the nerve-supply to the pharynx is unsettled, but it is probable that the levator palati is supplied by these fibres, since paralysis of the vocal cord, tongue, and palate is occasionally due to disease at the surface of the medulla in this region (Hughlings Jackson). The lower, spinal, fibres of the nerve emerge from the side of the cord as low as the sixth or seventh cervical nerves, and pass through the substance of the lateral columns, arising from the anterior cornua, in common with the motor fibres of the upper cervical nerves. This spinal part of the nerve ascends through the foramen magnum, and is connected with the bulbar portion for a short distance; the two parts then separate, the latter joining the pneumogastric, the former passing to the neck, and supplying the sternomastoid and the upper part of the trapezius.

1. **Paralysis.**—Ætiology.—The nucleus of origin of the nerve may be diseased by slow degeneration of the motor cells, as in progressive muscular atrophy and chronic bulbar paralysis. In the former the upper part of the trapezius, supplied by this nerve, is usually affected later than any other muscle; it is the *ultimum moriens*, as Duchenne called it. The nucleus of origin, especially the bulbar portion, may be damaged by acute processes, softening or hæmorrhage (acute bulbar paralysis). The fibres of origin are sometimes damaged by injuries, such as fracture or dislocation of the upper cervical vertebræ; by narrowing of the foramen magnum; by tumours external to the cord; and especially by meningitis, syphilitic or simple, in this region. The spinal part of the nerve, from its long course, is especially liable to suffer. The nerve is rarely injured in fractures of the skull. The causes of paralysis of the vagal portion, after its junction with the pneumogastric, have been considered in the article on diseases of that nerve. The spinal part, in its course to the muscles, may suffer in rare cases from rheumatic inflammation, or from injury; may be compressed by enlarged glands; or implicated in abscesses in its neighbourhood.

Symptoms.—Paralysis of the spinal accessory may be total, when the disease involves the nerve where both parts are united, but is much more commonly partial, on account of the extensive origin of the spinal portion, and the early separation of the two divisions. The symptoms indicating disease of the accessory part of the nerve, as loss of movement of the vocal cords, are described in the article on the pneumogastric nerve. The paralysis of the palate, which is so often associated, is best recognised by the defective movement in phonation.

The loss of function of the spinal portion of the nerve is shown by paralysis of the muscles which it supplies—the sternomastoid and trapezius. Unilateral paralysis of these muscles does not affect the posture of the head, but the head, when behind the vertical position, cannot be rotated to the opposite side. Paralysis of the trapezius, which may occur alone if the disease of the nerve is behind the sternomastoid, is confined to the upper part of the muscle, that proceeding from the occipital bone to the clavicle. The middle part of the muscle receives a sufficient nerve-supply from the cervical nerves to prevent conspicuous paralysis or wasting. The loss of the upper part alters the contour of the neck, and the shoulder is not raised in deep inspiration. The shoulder can, however, still be elevated voluntarily, this movement being effected by the middle part of the muscle. Abduction of the arm by the deltoid is interfered with, on account of the loss of the support afforded by the upper part of the trapezius, and the supplemental action of other muscles causes a slight rotation of the scapula. The paralysed muscles undergo wasting, which is usually rapid, and is accompanied by the reactions which characterise nerve-degeneration.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the spinal accessory

nerve are those of the morbid process causing the paralysis. In all cases, if the muscles waste and present loss of irritability, electricity should be applied, the voltaic current being in most cases required.

2. **Spasm.**—The muscles supplied by the spinal accessory nerve are frequently the seat of spasm, causing 'torticollis,' or 'wry-neck.' The spasm is due to an affection of the centres, probably above the nucleus of the nerve, and is described in a special article. *See* WRY-NECK.

W. R. GOWERS.

**SPINAL CORD, Diseases of.**—Though the spinal cord is commonly regarded as a single organ, it is one which is very composite in structure, and still more so in function. It is in part (1) a mere aggregate of connecting fibres between the body generally and the brain—that is, an accumulation of channels of conduction for sensory impressions of all kinds, both superficial and deep, on their way to the brain; and also for outgoing motor incitations from the brain to all voluntary muscles of the body, as well as to those pertaining to the viscera and their ducts, and to blood-vessels. In part, however, the cord also consists (2) of a serial aggregation of more or less fused ganglia having to do with the execution of voluntary and all sorts of reflex actions; with the functional activity of organs; and with the nutrition of tissues.

The structural bases for these two principal sets of functions are most intimately knit together; those of the second set are not wholly distinct from those of the first—to a considerable extent they are the same elements, capable of being called into play voluntarily, as well as in a reflex manner.

In order to facilitate references in the special articles on diseases of the spinal cord to the details set forth in this *Introduction*, it will be divided into a series of numbered sections.

§ 1. **General relations of the spinal cord.**—Continuous with the medulla oblongata above, the spinal cord begins at the level of the upper border of the body of the first cervical vertebra, whilst it ends in a narrow-pointed extremity opposite the upper part of the body of the second lumbar vertebra, or perhaps a trifle higher. Throughout the whole of this extent it is enclosed within the narrow spinal canal, and is invested by two membranes, the *pia mater* and the *arachnoid*. Beneath the latter and in the meshes of the looser pia mater there is situated (as over the cerebrum) a certain amount of cerebro-spinal or subarachnoid fluid. Enveloping the cord much more loosely, outside the arachnoid, is the firm spinal *dura mater*.

§ 2. ANATOMICAL DATA CONCERNING THE STRUCTURE OF THE SPINAL CORD.

The arrangement of the several anatomical components of the spinal cord is essentially similar throughout its extent. Its two halves are marked off from one another in front by the deep 'anterior longitudinal fissure' (fig. 85 A), and posteriorly by a median septum of connective tissue rather than by an actual fissure. Each half contains a central mass or core of grey matter, shaped something like a comma. The grey masses in the two halves of the cord are turned back to back, and are connected with one another by means of an intervening bridge of matter, answering to the 'grey commissure.' In front of this bridge of grey matter lie some white fibres, which constitute the 'white commissure.' Through the centre of the grey commissure there runs a fine central canal—the *canal of the cord*—which is lined with a layer of epithelium-like cells.

The thick anterior extremity of the grey matter in each half of the cord is known as the *anterior cornu*, and the much thinner posterior extremity as the *posterior cornu*. This latter approaches near to the surface of the cord in its postero-lateral region, and is here joined by the *posterior roots* of the spinal nerves. Their point of entry on each side divides the white substance of the corresponding half of the cord into posterior and antero-lateral columns. The portions of the white substance of the cord lying behind and between the posterior roots, constitute the two *posterior columns*, each of which is again subdivided by a slight superficial fissure into an external tract or *root-zone*, and an internal

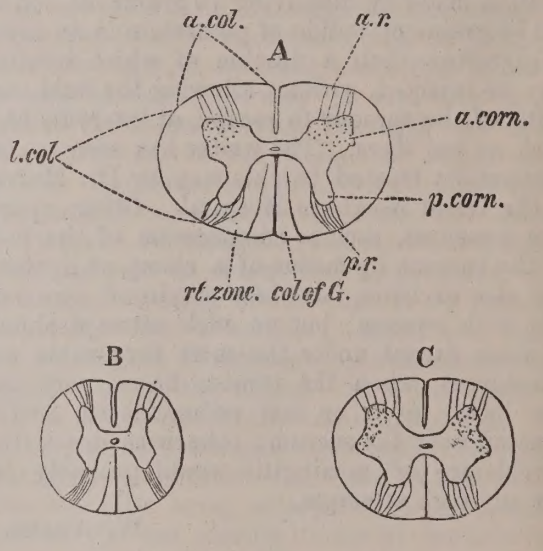


FIG. 85.—Transverse sections of Spinal Cord, 1½ natural size. A. Through middle of cervical swelling; *a. col.*, anterior column; *l. col.*, lateral column; *rt. zone*, root zone; *col. of G.*, column of Goll; *a. r.*, anterior roots; *p. r.*, posterior roots; *a. corn.*, anterior cornu; *p. corn.*, posterior cornu. B. Section through mid-dorsal region. C. Section through middle of lumbar region.

(These figures show, accurately, the relative proportions of the different component parts of the cord in the three situations named.)

wedge-shaped portion, or '*column of Goll*.' The portions of the white substance which on each side lie in front of the posterior roots constitute the *antero-lateral columns*. The inner portions of the anterior columns border upon the anterior fissure, but there is no real line of demarcation to define the bounds of the anterior and of the lateral columns respectively, because the anterior roots are connected with the anterior cornua in a diffuse or scattered manner, and not in a compact bundle like that formed by the fibres of each posterior root.

For some particulars concerning the *blood-vessels* of the spinal cord, *see* § 6, (8) and (9).

§ 3. PHYSIOLOGICAL DATA CONCERNING THE SPINAL CORD.

**In going channels of conduction to the brain.**—The paths for these impressions soon after their entry into the spinal cord by the posterior roots cross to the opposite half of the cord, decussating with their fellows of the other side.

Impressions of touch, pressure, temperature, and tickling travel in the main by the *posterior columns*—though probably some of them ascend in portions of the lateral columns.

Impressions producing pain, after passing with the nerve-roots through portions of the posterior columns, principally traverse the grey matter of the cord. Disease or damage of these posterior columns, as well as of the grey matter, often causes a more or less marked retardation in the transmission of such impressions.

The path traversed by impressions from muscles to the encephalon (so important for the regulation of movements) is not distinctly known—but it is to be found possibly in the posterior columns. These channels are said by Brown-Séquard to decussate in the pons Varolii, rather than soon after their entry into the spinal cord.

The path for the transmission of impressions from the 'genital centres' in the lumbar region of the cord to the brain, is also probably situated in the posterior columns.

The physiological anatomy of the cord in the lumbar region seems to be slightly different from what it is higher up in the dorsal and cervical regions, since in the former situation ordinary sensory impressions from the lower extremities are said to pass through the lateral, rather than through the posterior columns. Those from the pelvic region, the sexual organs, the perinæum and anal regions, however, are supposed to pass upwards through the posterior columns.

§ 4. **Outgoing channels of conduction from the brain.**—All that is certainly known concerning the paths for voluntary motor incitations is that, below the decussation of the pyramids, they are to be found mainly in the posterior part of the lateral column ('crossed pyramidal tract'). The fibres descend through these columns to different levels, according as their stimuli are destined to evoke the activity of different nerves and muscles; thus, if a movement of the arms is to be excited, they go only as low as to some part of the cervical enlargement; but if the movement is of the legs, as far as to the lumbar swelling. In each case such motor fibres then penetrate the grey matter (anterior horns), and come into relation with some of the great nerve-cells contained therein, whence outgoing fibres arise, which cluster together outside the cord and constitute the fibres of the anterior roots. The motor paths for the foot and leg, in the lumbar lateral column, are said to lie more towards the circumference of the cord than those for the thigh-muscles.

On the other hand, some (see p. 1460) of the pyramidal fibres of the medulla pass into and through the spinal cord on the same side, that is without decussating, and constitute the inner part of the anterior columns ('direct pyramidal tract'). Some of its fibres are thought to cross into the anterior horn of the opposite side, by means of the anterior or white commissure. Whence these fibres come, and what is their precise function in relation to those of the 'crossed pyramidal tract,' no one as yet seems to know. These are questions still unsolved; the only common point of agreement is, that these fibres of the 'direct pyramidal tract' are in some way concerned with movement rather than with sensation.

It is probably an error to suppose that there are any special routes for the conduction of reflex motor impulses from the brain, apart from those concerned with the excitation of voluntary movements.

Again, it is not known that any separate motor fibres are prolonged into the spinal cord from the cerebellum. But it seems highly probable that certain of the ingoing channels of conduction pass from the cord to the cerebellum, as well as to the cerebrum. Some of these may be situated in the posterior median columns, and some in the outer part of the lateral columns ('direct cerebellar tract' of Flechsig).

§ 5. **Spinal reflexes.**—The reflexes of purely spinal mechanism which are of importance (by their presence, absence, or variation) as indications of disease of the spinal cord in different longitudinal regions have been divided into (*a*) the superficial or *skin* reflexes, and (*b*) the deep or so-called '*tendon* reflexes.'

(*a*) *Skin reflexes.* The most important of these are tabulated below. The designation of the parts of the cord upon which they severally depend is based upon a very useful table published by Dr. Gowers.

| Name of Reflex | Mode of Excitation. | Nature of Result | Level of Cord upon which Reflex depends |
|---|---|---|---|
| *Plantar reflex* | Tickling sole of foot . . | Movements of toes; of these and foot; or of these and leg. | 1st, 2nd, and third sacra nerves (lower part of lumbar enlargement) |
| *Gluteal reflex* | Irritation of skin of buttock . | Contraction of glutæi . . | 4th and 5th lumbar nerves |
| *Cremasteric reflex* | Irritation of skin of upper and inner part of thigh | Drawing up of testicle . . | 1st and 2nd lumbar nerves |
| *Abdominal reflex* | Irritation of skin of abdomen along edge of ribs, and above Poupart's ligament | Contraction of upper or of lower part of abdominal muscles | 8th to 12th dorsal nerves |
| *Epigastric reflex* | Stroking side of chest over 6th and 5th intercostal spaces | A dimpling of corresponding side of epigastric region (contraction of highest fibres of rectus abdominis) | 4th to 6th or 7th dorsal nerves |
| *Scapular reflex* | Irritation of skin in interscapular region | Contraction of posterior axillary fold (teres), or of several of scapular muscles | 6th or 7th cervical to 2nd or 3rd dorsal nerves |

These skin-reflexes vary much in different individuals, as regards the facility with which they may be obtained. They are often more marked in children and in women than in men; though when the latter are of an irritable or nervous temperament, some or all of the skin-reflexes may in them be well-marked even in conditions of health.

In cases where extensive transverse lesions exist, situated higher up in the cord than the nerves upon which any of these reflexes depend, such reflexes are commonly supposed to be exaggerated in intensity. This, however, is not always the case. The fact that this or that reflex exists, shows not only that the afferent and efferent nerves, but that the track through the spinal cord at the corresponding level, is practically undamaged. It is not, however, necessarily true that absence of either of the reflexes is an indication of disease at the corresponding level in the spinal cord. It may be so; but it may also be that the disappearance of the reflex is dependent upon disease in some part of the afferent or of the efferent nerves, leaving the cord itself intact. Or it may also happen that the particular reflex is simply not to be obtained in the individual under examination. Or, again, with a complete transverse lesion in the lower cervical region, under certain conditions, all reflexes dependent upon lower portions of the cord may (though contrary to usual beliefs) be abolished. *See* **Spinal Cord, Softening of.**

Further, it must be borne in mind that in certain cases of hemiplegia (even where hemianæsthesia does not co-exist) these skin-reflexes are often notably diminished or even abolished on the paralysed side of the body; though the reverse condition of things will probably obtain in regard to the deep or 'tendon reflexes' next to be considered. It will probably be found, hereafter, that this repressing effect upon the skin-reflexes is associated with the existence of lesions in special parts of the brain, and not with lesions in other localities, though such several sites are at present very imperfectly known.

(*b*) '*Tendon reflexes.*' Much discussion has taken place as to whether these are 'reflexes' at all, in the proper sense of the term. Into this question we do not propose to enter. The phenomena themselves, to which alone reference will be made, are chiefly two in number, namely, *ankle clonus*; and that variously known as the *knee phenomenon, patellar tendon reflex, knee reflex*, or *knee jerk*.

There is a distinct difference in regard to these two phenomena. The 'knee jerk' occurs in health, so that it is its absence which is of principal significance in certain diseases. 'Ankle clonus,' on the contrary, is a phenomenon not to be obtained in a state of health, so that its presence is thought by some to be a positive sign of disease of the spinal cord. This is a view which requires limitations—and limitations of such a kind as to deprive the manifestation of ankle-clonus of much of its diagnostic significance. It may exist, for instance, after one-sided fits dependent upon disease of the cerebral cortex; and, again, it may exist to a well-marked extent where the antero-lateral columns of the cord are pressed upon at a certain level, even though (as in the condition above referred to) no lateral sclerosis of the cord has been developed.

| Name of Reflex | Mode of Excitation | Nature of Result | Level of Cord upon which Reflex depends |
|---|---|---|---|
| *Knee jerk* | By striking patellar tendon with edge of hand or with percussion hammer, whilst leg hangs loosely over fellow, or over forearm of operator. Also by striking quadriceps tendon, above patella | A single upward jerk of the leg and foot, slight or distinct | 2nd and 3rd lumbar nerves |
| *Ankle clonus* | With knee extended or very slightly flexed, by pressing quickly and firmly against anterior part of sole of foot (so as to stretch calf-muscles) and then keeping up the pressure | A series of clonic contractions at the ankle-joint, continuing as long as the pressure is maintained, and instantly ceasing when it is relaxed. If the condition is very highly marked it may spread to the whole limb, or even to that of the opposite side. | 1st to 3rd sacral nerves (lower part of lumbar enlargement) |

Both these physical signs have lately attracted much attention. Ankle clonus was originally described by Brown-Séquard in 1858; it was more particularly defined in the human subject by MM. Charcot and Vulpian in 1866; and its diagnostic importance has since been repeatedly enforced by these observers. In 1874 the mechanism of the knee-jerk, and the fact of its absence in certain spinal diseases, especially locomotor ataxy, began almost simultaneously to engage the independent attention of Erb and of Westphal, and subsequently of many other observers.

For a brief reference to the functional activity of the *vaso-motor centres*, and of their nerves emanating from the spinal cord, *see* § 9, (4) and (5).

§ 6. Pathological Data concerning the Spinal Cord. (General Ætiology and Pathology.) The spinal cord itself may be damaged by disease invading it *from without*—that is, taking origin either in the bony canal or in the enveloping membranes; or it may be the seat of *intrinsic* pathological changes. As the former conditions may and do constantly produce functional derangements or actual structural changes of a secondary order in the cord itself, we must take cognisance of them here, so that the various

peculiarities as to their occurrence may be made known and considered side by side with those pertaining to the different causes of disease of intrinsic origin, from which they have to be distinguished at the bedside.

(*a*) **Extrinsic causes.**

(1) *Stabs or bullet-wounds* may involve limited regions and parts of the spinal cord.

(2) *Fracture with dislocation of some of the vertebræ* (as results of severe falls or other mechanical violence) exists as an occasional cause of an associated paraplegia, produced by the crushing of, or pressure upon, the spinal cord. This is most apt to occur in the cervical region, though the dorsal and lumbar regions are, to a less extent, liable to similar accidents.

(3) *Scrofulous caries of the vertebræ* may exist in either region, and may or may not be associated with *angular curvature* in a corresponding portion of the spine. The paraplegia or other result of interference with the functions of the cord in the majority of cases of this disease, is not due so much to its compression by diseased bone, as to the irritation and subsequent compression of the cord by inflammatory products.

(4) *Cancer of the vertebræ* occurs either as a primary or as a secondary affection. Such a new growth may involve the dura mater or not, and as it grows it may at first irritate and subsequently compress the spinal cord itself.

Other diseases of the spine are rare as causes of disease of the spinal cord. Still aneurysmal erosion of vertebræ with subsequent pressure upon the cord must not be forgotten, and rarely an aneurism bursts into the spinal canal. Exostoses and enchondromatous growths from the bones may also quite rarely compress the cord.

(5) *Cancer of the spinal meninges, or new growths of other kinds* (*see* MENINGES, SPINAL, Diseases of), may also involve irritation, and subsequently compression, of the anterior or posterior nerve-roots or of the spinal cord itself in one or other region. *Hydatids*, again, should be remembered as possible causes of spinal disease, especially where their existence has already been detected in the body in other situations.

(6) *Hæmorrhage into or upon the Meninges.* *See* MENINGES, SPINAL, Diseases of.

The foregoing groups of causes of disease of the spinal cord, give rise to sets of symptoms having a generic resemblance, because in each case *compression* acts upon the cord, or upon the spinal roots and cord, from without, in one or other direction.

(*b*) **Intrinsic causes.**

(7) *Hæmorrhage* occurs with extreme rarity in the spinal cord. This is due, in the main, to the firmer texture of the cord, and to the greater abundance of supporting connective tissue around its blood-vessels, as compared with those of the brain. When hæmorrhage, of idiopathic origin, does take place into the spinal cord, it almost invariably occurs in the softest portion of the organ, namely, its central core of grey matter—and in this region it may extend for some distance upwards and downwards. As a result of falls or blows, also, hæmorrhage into the substance of the cord is a rare event; still, under these conditions, it occurs occasionally—mostly in association with laceration of the substance of the cord. Of this latter kind of lesion, resulting from a fall from a height of about 25 feet, the writer has recorded a remarkable instance (*Med.-Chirurg. Trans.* vol. l., 1867), in which, although the cord was lacerated, there was no external wound and no fracture or dislocation of vertebræ.

(8) *Embolism* occurs with great rarity in the spinal cord, and is still more seldom recognised when it does occur. This is due to the fact of the small size of the arteries of the cord—the absence among them of any large trunk, like the middle cerebral, coming off more or less directly from one of the great vessels arising from the arch of the aorta. Emboli reach the brain much more rarely by way of the vertebrals than by way of the carotids; and the principal arteries of the spinal cord are either direct offsets from the vertebral (anterior spinal), or indirect branches from the same (posterior spinal)—the latter arising from the inferior cerebellar, which are twigs from the termination of the basilar artery. Apart from these vessels, the blood-supply of the cord comes from still smaller twigs, derived from the intercostal and lumbar arteries, which anastomose with and reinforce the anterior and posterior vessels, at intervals, along the whole length of the cord. All the principal vessels, small though they are, seem to anastomose freely with one another. Thus, even if embolism of spinal arteries should occur at times, as it probably does, its effects would be diminished in importance and obscured clinically as well as *post mortem*, by reason of these vessels not being 'end' arteries.

(9) *Thrombosis* would, however, be capable of occurring in diseased spinal *arteries*, as well as in those of other parts of the body. Subsequent observations may perhaps show that degenerative changes or endarteritis are particularly common in the spinal arteries, so that the occurrence of thrombosis in them would thereby be rendered all the more easy and likely to occur. A similar process may also take place in the peculiarly tortuous network of *veins* which surrounds the spinal cord on all sides—perhaps even with more facility than in the veins of other parts—when general and other local conditions favour its occurrence. Ollivier calls attention to the probably natural slowness of the blood-current through the spinal veins, and to the multiplicity of causes which, owing to their influence upon respiration and cardiac action, tend still further to retard it—such as violent emotions or efforts, and those diseases which greatly interfere with respiration, or with the force and regularity of the heart's action. He adds that he has often seen in elderly persons fibrinous clots filling the veins of the cord, as well as those which accompany its nerve-roots.

Thus one of the common causes of ordinary degenerative softening as it occurs in the encephalon, would also be operative in the cord.

(10) *White softening* of the spinal cord is very common; often implicating its whole transverse area for a variable extent. It differs in no respect in its naked-eye or microscopical appearances from the process as it is met with in the encephalon. It is altogether unreasonable to assume, in accordance with current nomencla-

ture, that this condition is mostly a result of inflammation and therefore to be spoken of as a *myelitis*, when the pathologists of our time have declared that the similar process in the cerebrum and cerebellum is mostly of degenerative origin.

(11) *Myelitis.*—The writer is far from denying that primary *inflammation* may involve areas of the cord, and entail 'softening' of its substance. He believes, however, that 'acute myelitis' is far more likely to occur as a secondary process, in connection with pressure upon and consequent irritation of some part of the cord, encroached upon by fractures or dislocations of the vertebræ, or otherwise wounded; also as an occasional sequela of scrofulous vertebral caries, of the direct pressure made upon the cord by some meningeal tumour, or of hæmorrhage into its substance. Yet he is far from believing that *all* the secondary softenings met with in the spinal cord are necessarily of inflammatory origin. Many of these also are due to degenerative rather than to inflammatory causes.

Processes of degenerative 'softening' are mostly brought about quickly, and they would, in the main, correspond with what is commonly spoken of as 'acute myelitis.' As for 'chronic myelitis' (in the commonly understood sense of chronic softening) the writer believes that no such disease should be any longer described. Many 'softenings' are in a certain sense chronic, as, though they may be more or less abrupt in their onset, they tend to last long rather than to kill quickly. Again, other maladies which the older physicians would have ascribed to 'chronic myelitis' or 'chronic softening,' are now known to partake more of the nature of chronic indurations, and to have as their bases processes of sclerosis.

(12) Processes of *sclerosis* are extremely common in the spinal cord. In nature they are over-growths of the connective tissue of this organ altogether similar to those occurring in other organs and tissues, under the name of 'fibroid substitutions' or 'non-inflammatory hyperplasias of connective tissue.' Yet here, again, certain pathologists would have us see results of inflammation, and they accordingly speak of such changes as examples of 'chronic myelitis.' Sclerosis occurs under various forms, and constitutes the basis of several distinct diseases, which are in all cases gradual and more or less slow in their onset, as well as in their progress. It may occur (*a*) as a *diffuse* general overgrowth (after the manner of a cirrhosis in other organs); (*b*) in the form of *bands* limited to particular columns of the cord (especially the posterior and the lateral); or (*c*) in an *insular* manner, so as to form islets of sclerosis, scattered altogether irregularly through the cord at different levels, as in 'disseminated sclerosis.'

(13) Tissue-changes allied to these in their results or later stages, though they have a peculiar history and course of their own at the commencement, are the so-called '*secondary degenerations*' which occur in certain regions of the cord as a result either of some previous damage or injury to this organ itself, or as a sequence of brain-disease.

These 'secondary degenerations' illustrate facts originally made known by Waller, but which were confirmed and extended by Phillipeaux and Vulpian, to the effect that when nerve-fibres are severed from their connections with ganglion-cells situated at one or other extremity, the white substance of Schwann gradually breaks up in the course of seven to fourteen days, and undergoes a process of fatty degeneration, by which it is ultimately resolved into a multitude of mere molecules and fat-particles. The white columns of the cord are composed of great aggregations of nerve-fibres running parallel with one another, so that when one of these columns is cut across, or when the continuity of its fibres is interrupted by some severe lesion occurring in their midst, a process of 'secondary degeneration' manifests itself simultaneously in all the fibres thus damaged; and the united result appears as a band-like tract of degeneration, running upwards or downwards in the particular column of the cord affected.

In order to deal as briefly with this subject as possible, it may be said that experience has hitherto shown that such band-like tracts of 'secondary degeneration' occur especially in each lateral half of the cord, in three situations, namely, (1) in the lateral columns; (2) in the inner portions of the anterior columns; and (3) in the posterior columns. The degenerations in the lateral and anterior columns take place in each in a direction downwards from the site of section or lesion of the fibres, at whatever level the damage may chance to exist; whilst those in the posterior columns take place in an upward direction, starting from the section or seat of destructive lesion by which these columns may be invaded.

The fibres that undergo the *descending degeneration* in the lateral columns are generally believed to be those which transmit volitional stimuli to the various voluntary muscles of the body, and which have been previously alluded to as coming into relation with motor cells in the anterior cornua at different levels. These different fibres are supposed to enter the lateral columns at the commencement of the spinal cord, passing into them, in fact, as a result of the 'decussation of the pyramids.' Thus, the motor tract continued downwards from one corpus striatum, let us say the *left*, continues along the crus and through the pons on the same side; thence passing into the medulla a considerable proportion of its fibres decussate with their fellows and thereby reach the right lateral column, down which they proceed as a compact group in the manner indicated. The remainder of the fibres of the left motor tract (those which do not decussate) pass down also in a compact body and occupy most of the inner half of the left anterior column.[1] Thus, if the whole of the left motor tract be seriously damaged or cut across in the corpus striatum or at any point above the 'decussation of the pyramids' we should have a small band of degeneration in the anterior column on the same side, and also a larger band of degeneration in the opposite (or right) lateral column (fig. 86, H)— that is, we should have the form of secondary degeneration associated with many cases of hemiplegia.

[1] Though this is the rule, yet it would appear from the observations of Flechsig that developmental anomalies are apt to occur, so that the relative proportion between the decussating and the non-decussating fibres is subject to much variation in different individuals

But if there be complete section of or destructive disease involving the antero-lateral columns of one side of the cord itself, then we should have a band of degeneration in the anterior, as well as in the lateral, column of the same half of the cord. Or if either column be cut or damaged singly, then in such column a band of degeneration would be found extending downwards from

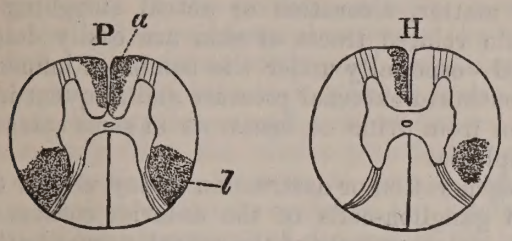


FIG. 86.—*P.* Showing descending areas of degeneration: *a.* in inner part of anterior columns; *l.* in lateral columns (mid-dorsal region). Case of *paraplegia*, from complete transverse softening in upper dorsal region.
*H.* Showing descending degenerations in case of *right hemiplegia*, from extensive softening of left corpus striatum. (Twice natural size.)

the seat of lesion. Or if, as so frequently happens, we have to do with a total transverse lesion, represented for instance by a focus of softening extending through the whole thickness of the cord in the upper dorsal or in some other region (so that the patient suffers from complete paraplegia), we should then find large areas of secondary degeneration in each lateral column below, as well as smaller areas in the inner part of each anterior column (fig. 86, P). The areas in both situations become less extensive as they descend, and gradually wear themselves out in the lower part of the lumbar swelling (see *Med.-Chir. Trans.* vol. l., pl. x.). It was stated by Bouchard, and has been commonly repeated by succeeding writers, that the areas in the anterior columns do not appear beyond the mid-dorsal region, but this, as the writer pointed out in 1867, is certainly not the rule.

In such a case as that last cited, namely, one of paraplegia due to a total transverse lesion in the upper dorsal region, there would be found above the seat of lesion certain *ascending degenerations* —the principal of which would be situated in the posterior columns, though others smaller and less commonly known are to be met with in the outer part of the lateral columns (fig. 87, P). The ascending degenerations in the posterior columns are often strictly limited to the so-called 'columns of Goll.' Situated on each side of the posterior median fissure, they together constitute a median wedge-shaped patch, whose apex extends forwards to the commissure, and whose base is at the posterior surface of the cord. This band of degeneration reaches upwards to the medulla, though the exact course of its fibres through this region is uncertain. Nothing definite, indeed, is known as to the functions subserved by the fibres composing the 'columns of Goll.' It seems clear, however, that, under certain conditions, the areas of ascending degeneration in the posterior columns may be differently arranged, and not completely limited to the 'columns of Goll,' since in a case with a lesion of some kind in the mid-cervical region (whose nature is not known because, unfortunately, this part of the cord was not preserved) the writer long ago found such areas as are represented in fig. 87, Px, in the upper cervical region and in the medulla. He then, as he has since, found ascending areas of degeneration occupying the superficial portion of the lateral columns, which were traced upwards into the restiform bodies. It would seem possible that the fibres which undergo degeneration in this latter case correspond with those of the direct

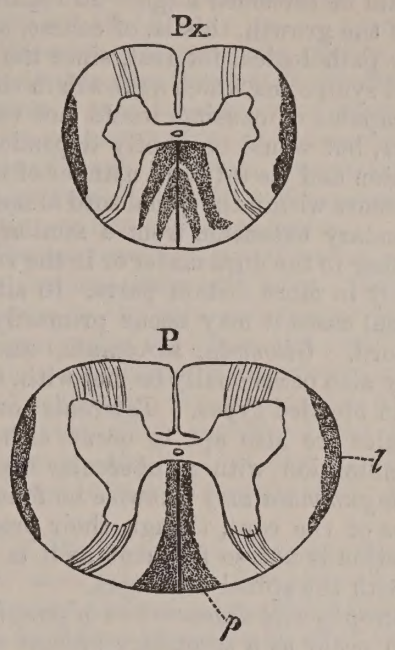


FIG. 87.—*P.* Showing ascending areas of degeneration: *p*, in columns of Goll; and *l*, along outer border of lateral columns, in middle of cervical swelling. Case of *paraplegia*, from complete transverse softening in upper dorsal region.
*Px.* Different arrangement of ascending areas in posterior columns in *upper cervical* region. (See *Trans. of Med.-Chir. Soc.*, vol. l., 1867, pl. ix.) (Twice natural size.)

'cerebellar band,' located by Flechsig in this situation. Such fibres would be afferent in function, but would probably only constitute a small part of the afferent fibres going to the cerebellum. (Nothing is known at present as to any band of efferent or motor fibres entering the cord from the cerebellum, and none such may exist. The cerebellar influence upon the motor tract —of whatever nature—may be expended upon certain centres situated in the pons varolii, or even in the corpora striata.)

In these areas of degeneration, in addition to the changes already mentioned as occurring in the nerves themselves, other processes take place. There is, for instance, a very distinct but secondary overgrowth of the connective tissue throughout the diseased area, as well as an abundant development of large granulation-corpuscles, precisely similar to those met with in ordinary foci of softened nerve-tissue. The granulation-corpuscles are closely packed amongst the meshes of the connective-tissue overgrowth and the atrophied nerve-fibres (see *Med.-Chir. Trans.*, vol. l. pl. xi. figs. 19, 20). In preparations which have been immersed in bichromates or in chromic acid, these corpuscles do not become stained to anything like the same extent as the healthy nerve-tissues; hence the areas containing them remain pale, and are consequently to be traced with the greatest ease in spinal cords which have been immersed for a week or two in these fluids,

though when they were in the fresh state no such areas may have been detectable, even on the most careful examination, by the naked eye.

(14) *New growths* in the substance of the spinal cord itself are not very common, nor, on account of the limitations of space within the spinal canal, do they ever attain a very large size. For this situation a growth equalling a hazel-nut in bulk would be esteemed large. In regard to the nature of the growth, this is, of course, a matter of purely pathological interest, since the clinical signs and symptoms which a growth in the spinal cord is capable of causing would not vary with its nature, but would be wholly dependent upon its situation and its rate and manner of increase. *Cancer* occurs within the spinal cord almost solely as a secondary extension from a similar growth pre-existing in the dura mater or in the vertebræ, or possibly in more distant parts. In altogether exceptional cases it may occur primarily in the spinal cord. *Gliomata*, *sarcomata*, and *myxomata* may also occasionally be met with, either in pure or in blended types. *Tubercular* or *scrofulous* nodules are also apt to occur, either alone or in combination with a tubercular meningitis. *Syphilitic gummata* may likewise be found in the substance of the cord, though their presence in this situation is not so frequent as it is in association with the spinal meninges.

(15) *Atrophy with degeneration of ganglion-cells* is apt to occur as a secondary process with extreme frequency in portions of the grey matter of the cord which happen to be more or less implicated by other contiguous pathological changes. But in two or three distinct diseases the ganglion cells of the anterior cornua, in different parts of the cord, are prone to be suddenly overtaken by an ætiologically obscure and altogether inexplicable failure of nutrition, which speedily reveals itself by entailing an atrophy of the particular cells affected. This, for instance, occurs as the anatomical basis of 'infantile paralysis,' and of the similar form of paralysis now known to occur (though more rarely) in adults. In these diseases whole groups of contiguous and functionally-related cells are affected simultaneously, and as the atrophy progresses, there is generally evidence of a secondary overgrowth of the neuroglia surrounding such nerve-cells, in the anterior cornua. To assume that this process is inflammatory in type, as the terms 'cornual myelitis' or 'acute anterior polio-myelitis' imply, seems to the writer altogether unwarrantable. Inflammation does not limit itself to individual tissue-elements, and the slight overgrowth of the contiguous neuroglia may well be a secondary process of simple hyperplasia. This latter process is indeed less evident where, as in 'progressive muscular atrophy,' the initial and mysterious atrophy of individual ganglion-cells occurs more slowly and more sparsely. Cells, here and there in particular groups, undergo in this affection the atrophic process, leaving others around them for a time as healthy as ever. Yet, as the disease progresses, the ranks of the healthy cells become gradually thinned in an altogether irregular manner; and this atrophy of nerve-cells, as it occurs, speedily entails, for reasons to be set forth in the next section, a corresponding atrophy of functionally related muscular fibres.

**§ 7. Trophic Relations between different Tissues and different parts of the Spinal Cord.**—Irritation of the posterior cornua, or of the posterior roots of the spinal nerves, may give rise to various pustular or vesicular eruptions in related portions of the skin, often associated with neuralgic pains in these same regions. In other cases, with lesions in some parts of the grey matter, ulceration or actual sloughing of certain related tracts of skin are easily determined—especially under the combined influence of continued external pressure and frequent irritation from urine or fæces, as in some cases of paraplegia.

Degeneration or destruction in any way of the great ganglion-cells of the anterior cornua, or of the anterior roots of the spinal nerves (either within or outside the cord), gives rise, in the course of two or three weeks, to atrophy of the muscle-fibres with which such cells or nerve-roots are in relation. We thus get an atrophic paralysis, associated with the electrical 'reaction of degeneration.'

Certain diseases affecting the grey matter of the cord (in ways and sites which cannot be precisely defined) are also apt to be associated with chronic diseases of the joints. Sometimes comparatively unimportant, they lead in other instances to great atrophy of the articular ends of the bones, and possibly to dislocation with utter destruction of the joint, as in some cases of locomotor ataxy. Atrophy, with brittleness of bones, may also be met with in the same or in allied cases.

The fact of the existence of these trophic troubles in association with such lesions, may be admitted wholly irrespective of the explanation of their pathogenesis. Whether they are due to altered states or influences transmitted by ordinary motor and sensory nerves in relation with such tissues, or to altered influences through certain purely hypothetical 'trophic nerves,' lies altogether outside the fact of the mere co-existence of the several trophic troubles with the several lesions—which is the point of more immediate interest for the practitioner of medicine.

§ 8. General Symptomatology, and General and Regional Diagnosis.—Taking them in conjunction with some of the simpler principles of nerve-physiology, the practitioner has to make use of the various kinds of data above enumerated in the investigation of the precise nature of every case of disease of the spinal cord which comes before him. Under the word 'nature' we include, of course, both sides of the diagnosis that has to be made, namely, the *regional* and the *pathological*.

The practitioner is compelled to interpret the patient's symptoms, and the various signs he is able to recognise for himself, by the aid of such data when he attempts, for instance, to ascertain what parts of the cord are damaged, and in what order they have been implicated. He may wish to know whether the posterior or the lateral columns are specially involved; whether the grey matter is much damaged; and, if so, whether the damage more particularly affects the anterior cornua or other parts. Again, he may wish to know whether the anterior or the posterior spinal nerve-roots are specially involved; and, if so,

whether they are merely irritated or more severely damaged, and whether they have been simultaneously or successively affected. For the present we shall concern ourselves with this aspect of the problem only, though it will subsequently be shown in our account of the several diseases of the spinal cord what light the coexistence of certain groups of these facts throws upon the other aspect of the problem, namely, upon the question of the pathological nature of the lesion.

Some of the facts already cited have, however, to be translated into their clinical equivalents, and to be supplemented by others derived more exclusively from the clinico-pathological study of spinal diseases, in order to form a series of data more immediately useful in the interpretation of the phenomena of diseases of the spinal cord in their regional relations.

**Regional Diagnosis.**—We already possess a number of valuable clinical data available for throwing light upon the regional side of the problem of diagnosis. It must be borne in mind, however, that the regional diagnosis of diseases of the spinal cord is itself a twofold problem. It involves a consideration: (*a*) of the *transverse area* involved; and (*b*) of the *longitudinal situation and extent* of the disease in such areas.

(*a*) **Diagnosis of the transverse area involved.**—The facts to be tabulated under this head may be set down in the order of their relation to different component parts or regions of the spinal cord.

(1) *Anterior roots of spinal nerves.*—Irritation of these may give rise to various forms of twitching or to tonic spasms in related muscles. Great pressure upon or destruction of the anterior roots will give rise to local paralysis in the related muscles, followed in the course of a week or two by marked atrophy, and the establishment of the electrical 'reaction of degeneration' (*see* Paralysis, Motor). There will also be an abolition of reflex excitability of these muscles in response to skin-irritation, or from blows upon or stretchings of their tendons.

(2) *Antero-lateral columns.*—Increasing pressure upon or disease of these columns gives rise to paresis, gradually deepening into motor paralysis of parts deriving their nerve-supply at or below the seat of lesion.

When the disease occurs in the lateral column more especially, there may be twitchings or startings in the muscles below, or well-marked spasms, and possibly painful cramps. There may also be great exaltation of the superficial and deep reflexes, if the manifestation of the latter is not hindered by pre-existing spasms. Motor paralysis exists to some extent, but without any appreciable impairment of sensibility. No marked wasting of muscles, or diminution in electrical reactions, usually occurs.

(3) *Grey matter.*—(*a*) *Of anterior cornua.*—Disease of these parts causes motor paralysis, with atrophy, loss of faradic excitability and of reflex excitability in related muscles—as in cases of disease of the anterior roots of spinal nerves.

(*b*) *Of posterior cornua and central parts.*—Damage of these regions of grey matter will, according to its completeness in transverse extent, cause more or less delay or defect in the transmission of painful impressions, and perhaps interfere also with other modes of sensibility.

Some trophic lesions in skin and joints may also be met with (*see* § 7).

*** At different levels in the cord special centres (represented in both anterior and posterior regions of grey matter) in connection with definite functions, may be interfered with by morbid conditions implicating the grey matter (*see below* § 9 [1–10]).

(4) *Posterior columns.*—The results of disease confined to this situation (more especially to the 'root-zones') will be—ataxy or signs of incoordination of movements; interference with impressions of touch, pressure, temperature, and of 'muscular sense'; abolition of knee-reflex; and diminution or loss of sexual desire.

(5) *Posterior roots of spinal nerves.*—From irritating lesions there will arise lancinating or other pains in the skin and deeper textures of related portions of the limbs, and possibly trophic skin-lesions. Pressure or destructive lesions will give rise to loss, in various degrees, of different modes of sensibility, superficial and deep; and diminution or abolition of the superficial and deep reflexes in related regions of the body.

§ 9. (*b*) **Diagnosis of the longitudinal situation and extent of the lesion.**—This is a consideration distinctly secondary to the other, since at whatever longitudinal level the disease may be situated, its clinical characters will always be qualified by the part or parts of the transverse extent of the cord that may be involved. Here we have to depend in the main upon the signs indicative of the *implication of particular sensory and motor nerves*, whose exact relations with different portions of the spinal cord are, of course, known. Such signs may consist of some excess or defect of sensibility, of motility, or of reflex action.

We are accustomed also to obtain information of a more general kind from the fact that *special centres* in connection with different viscera and functions situated at different longitudinal levels in the cord may be more or less deranged. To this portion of the subject it will, indeed, be found most convenient to give attention in the first place.

*Evidence from perverted activity of spinal centres.*

(1) The lateral columns in the upper cervical region contain the motor paths for the muscles of respiration, so that section or disease of them at a lower level interferes with the movements of respiration on the same side of the chest (thoracic muscles); whilst, if the lesion reaches as high as the fourth and third cervical nerves (the origin of the phrenic) the diaphragm itself also becomes paralysed, and the movements of respiration must therefore almost cease.

(2) Again, the upper cervical region of the cord, if it does not contain actual centres connected with the excitation of the heart's action, is at all events traversed by certain channels for the transmission of cardiac stimuli (whose point of exit from the cord is, with sympathetic fibres, lower down).

Thus different lesions in this upper cervical region of the cord may, according to their nature

and extent, greatly interfere with the heart's action, as well as with the respiratory movements. The frequency of the pulse may be either notably accelerated or retarded; whilst the respiratory movements may be slower or much quicker than natural, and also extremely irregular and perverted in rhythm.

(3) The lower cervical and upper dorsal regions of the cord also contain the so-called 'cilio-spinal centre,' or the fibres emanating from it. These pass outwards with the fibres of the anterior roots in the above-named regions, and thence into the cervical sympathetic. Irritation of them causes dilatation of the pupil on the same side, whilst section or other destructive lesion causes contraction of the pupil.

(4) The vaso-motor nerves for the side of the head and neck arise in similar regions of the cord, and leave it in the same manner. Irritation of them produces contraction of the blood-vessels; section, severe compression, or destruction causes dilatation of the blood-vessels of these regions. *See* SYMPATHETIC SYSTEM, Disorders of.

(5) Generally it may be said that section of one half of the cord or destruction of it for any extent longitudinally, causes at first paralysis of blood-vessels in the lower parts of the body on the same side—this vaso-motor paralysis carrying with it in the same parts an increase of temperature and an exaltation of sensibility. In a short time, however, the vaso-motor paralysis (and with it the increase of heat and sensibility) passes away, owing to the vaso-motor centres in parts of the spinal cord below, and to the peripheral vaso-motor centres, adapting themselves to act independently of those in higher parts of the cord and of the supreme regulating centre in the medulla oblongata. (As a rule the higher vaso-motor centres control those lower down, but after temporary paralysis even the peripheral vaso-motor centres seem to resume control over related blood-vessels.)

(6) The movements of the stomach and intestines generally are certainly influenced by the cord in different regions, so that in various cases, under perversions of this normal spinal influence, we may get vomiting, diarrhœa, or obstinate constipation—as direct results, that is, of morbid changes in certain parts of the cord in which intestinal sympathetic fibres have their roots. The exact situations of these centres and paths of stimulation are, however, only vaguely known.

In the grey matter of the lumbar swelling of the cord there are aggregated a number of centres having to do with important functions, which may be variously interfered with by disease. These centres are those which regulate—(7) the evacuation of the rectum; (8) the evacuation of the bladder; (9) erection and ejaculatio seminis; and (10) the contractions of the uterus.

In each case the spinal centre constitutes an independent reflex centre, provided with its afferent and efferent nerves, but in each case also there is more or less of connection between the spinal centre and others in the cerebral hemispheres. There must therefore be double sets of internuncial fibres for each centre traversing the whole length of the spinal cord and medulla; partly for the transference of afferent impressions from each centre to the brain, and partly for the conduction of efferent impressions in the reverse direction. In the case of the uterine centre these cerebral connections are of comparatively slight importance; since, with a complete transverse lesion in the cervical or even in the upper dorsal region, the process of parturition may still be successfully accomplished. So long as the spinal mechanism is complete and perfect, parturition may take place without the need of cerebral co-operation. Our subsequent remarks will, therefore, refer principally to the other three lumbar centres.

Complete transverse lesions occurring in any part of the dorsal or cervical regions will, of course, entirely cut off all the above-mentioned lumbar spinal centres from connection with, and therefore from any voluntary control by, the cerebral hemispheres. But various limited local lesions in particular transverse areas of the cord (though such areas cannot at present be definitely specified) may produce similar results, so far as the cerebral control of any one or two of the lumbar centres is concerned. According as the severance of these lumbar spinal centres from cerebral correlation and control is complete or partial, one or other of the following results would be produced:—

| Name of Centre | Complete Severance from Cerebrum | Incomplete Severance from Cerebrum | |
|---|---|---|---|
| | Afferent and Efferent Internuncial Fibres | Afferent Internuncial Fibres Only | Efferent Internuncial Fibres Only |
| *Recial centre* . | Unconsciousness of need, and inability to prevent evacuation *Result.*—Constipation, with incontinence of fæces after an aperient | Unconsciousness of need and therefore no attempt to restrain evacuation | Consciousness of need to evacuate, with no ability to restrain the act |
| *Vesical centre* . | Unconsciousness of need, and inability to prevent micturition *Result.*— Reflex evacuation in gushes at intervals | Unconsciousness of need and therefore no attempt to restrain micturition | Consciousness of need, but inability to restrain micturition |
| *Sexual centre* . | Diminution or absence of sexual desire. Erections and emissions, if they occur, wholly dependent upon the spinal reflex mechanism | With simple destruction of fibres, nearly same results as set down in previous column; but with *irritation* of afferent fibres there might be great increase of desire (satyriasis or nymphomania) | Feelings of desire, but no erection in response. Erection and emissions, if present, purely through spinal reflex. But with *irritation* of efferent fibres there may be persistent erections, mostly without desire |

The *rectal* and the *vesical spinal centres* are each composed of two parts with their separate afferent and efferent nerves—one in relation with a sphincter muscle, and the other in relation with detrusor or expulsive muscles in functional opposition with the former. These several nerve-fibres, both afferent and efferent, are probably all contained in the sacral nerve-trunks—that is, they both reach and leave the lumbar swelling as constituents of these nerve-trunks. Destruction or irritation of either of these sets of fibres, or of one of the centres, will necessarily interfere to some extent with the working of this particular centre, so that its functions may be interfered with in several different ways. There may be various degrees of irritability of the bladder or rectum, or various degrees of paralysis of these organs.

In cases of paralysis of the bladder, especially when owing to lesions implicating its spinal centre, the urine soon becomes fœtid and alkaline, and inflammation (alone or with ulceration) is most apt to be set up in its mucous membrane.

The details as to the modes of disturbance of the *genital* function, where disease implicates its lumbar centre or the afferent and efferent nerves in connection therewith, are both less known and of less clinical importance than where it involves the internuncial fibres between this centre and the cerebrum. Again, should the lumbar portion of the cord become affected in a pregnant woman so as to involve the *uterine centre*, unless the contents of the womb were thrown off during some initial period of irritation, this organ would be quite incapable of expelling the fœtus and its accessories.

*Evidence from implication of particular sensory or motor nerves.*

§ 10. The more precise indications concerning the longitudinal implication of the spinal cord are, as already stated, derivable from the level at which alterations in sensibility or in motility (either voluntary or reflex) are to be detected. The more closely the lesion approaches to what is called a 'total transverse lesion,' the more distinctly will signs of this order reveal themselves. It is important, too, to recollect that the fibres of different sensory roots are to some extent dispersed through cutaneous surfaces overlying the muscles supplied by the corresponding motor roots.

In regard to *sensibility*, the upper limit at which the trunk is affected is often sharply defined by the presence of a feeling of constriction, of pain, or of numbness ('girdle sensation') encircling the body. This sensation is generally supposed to be due to irritation of the roots of the nerves as they traverse the posterior columns (or perhaps outside them) at the upper level of the lesion. This symptom may of course be absent, but in many cases of paraplegia it is well-marked.

Then again the muscles which are paralysed can generally be pretty well defined, so that a reference to the nerves by which they are innervated will also enable us to fix upon the region of the cord from which they proceed. Thus we obtain indications as to the upper level of disease in the *motor* tracts.

These latter indications are, however, by no means so distinct as many might suppose, because the majority of limb and trunk muscles receive fibres from more than one motor root, as Preyer and Krause showed long ago. And the view subsequently indicated by E. Remak that functionally related or synergic muscles are represented together in the anterior horns of the spinal cord has been confirmed and extended by Ferrier and Yeo (*Proceed. of Royal Soc.*, March 24, 1881, p. 12), by their experiments on the functional relations of the motor roots. They find that stimulation of individual roots of the brachial and crural plexuses result, not in mere unrelated contractions of various muscles, but in highly co-ordinated synergic contractions, leading to definite movements. But as the 'muscles thrown into action by each root are innervated in most cases by several nerve-trunks,' the result 'of section of each motor root would therefore be paralysis of the corresponding combination, not necessarily, however, of the individual muscles involved . . . . whilst *weakened*, they might yet act in other combinations in so far as they were supplied by other roots.' Different combined movements which have been found to be dependent upon particular motor roots are cited by the authors in this valuable paper.

The integrity of those *reflex* actions which can be elicited either in health or in disease, depends, of course, upon the integrity of the entire nervous arcs concerned (that is, upon integrity of in-going fibres, centres, and out-going fibres). Thus though the impairment of a reflex *may not necessarily* be due to central causes, its presence, on the other hand, clearly shows that the grey matter and other regions of the cord which must be traversed by its stimuli are not impassable; whilst its exaltation will indicate the probable existence of some central change, by which the grey matter in question is rendered more excitable, or else by which it is cut off from cerebral inhibitory influences.

§ 11. For practical purposes it will be well here to group together the various indications as to longitudinal localisation to which we have referred—classifying them as they are related to one or other of four imaginary segments of the spinal cord.

(*a*) **Cervical region of the cord.**—*This corresponds externally to the space between the occiput and the upper border of the 7th cervical spine* (*8th cervical nerve*).

The 1st, 2nd, and 3rd cervical spinous processes are respectively opposite the origins of the 3rd, 4th, and 5th cervical nerves. The phrenic nerve (motor nerve of the diaphragm) arises from the 4th, or from the 3rd and the 4th cervical nerves. Opposite the 3rd cervical spine (level of 5th cervical nerve) the cervical swelling of the cord begins; whilst it ends opposite the 7th cervical spine (level of 1st dorsal nerve).

Disease of this region may involve interference with respiration, and possibly weakness of voice; interference with the heart's action—pulse very frequent, or the reverse; flushing or pallor of the head and neck; continued priapism (with crushing lesions); augmentation of temperature in the body generally (hyperpyrexia); and marked contraction or dilatation of the pupil.

The innervation of the shoulder, arm, and hand muscles is derived from spinal nerves between the 6th cervical and 1st dorsal inclusive; those supplying the ulnar side of the hand and forearm arising from the lower level, that is, from the upper part of the next region.

(*b*) **Upper half of the dorsal region of the cord.**—*This corresponds externally to the space between the 7th cervical spine* (*1st dorsal nerve*) *and the 4th dorsal spine* (*6th dorsal nerve*).

The results of disease here are apt to be these:—The 'scapular reflex' may be abolished, calling into activity as it does the last two or three cervical and the first two or three dorsal nerves; the intercostal muscles are paralysed at different levels; a 'girdle sensation' is felt at different levels; there may be prominence of certain vertebral spines, and possibly tenderness on pressure or on tapping over them; the 'epigastric reflex' may be abolished, depending as it does upon the spinal cord at the level of the 4th to the 6th or 7th pairs of dorsal nerves; and priapism (with crushing lesions) may occasionally be met with.

(*c*) **Lower half of the dorsal region of the cord.**—*This corresponds externally to the space between the upper border of the 5th dorsal spine* (*7th dorsal nerve*) *and the lower border of the 10th dorsal spine* (*space below 12th dorsal nerve*).

Disease here may give rise to the following symptoms:—The 'abdominal reflex' may be abolished, depending as it does upon the integrity of the cord between the levels of the 8th dorsal and the 1st lumbar nerves. Paralysis of lower intercostal muscles or of abdominal muscles may possibly occur, in addition to paralysis of the lower extremities. 'Girdle sensation' may be felt at different levels (the umbilicus corresponding with the 10th dorsal nerve, and the 'ensiform area' with the 6th and 7th dorsal nerves). There may be prominence of certain of the lower dorsal spines, with possible tenderness.

(*d*) **Lumbar region of the cord.**—*This corresponds externally to the space between the lower border of the 10th dorsal spine* (*just below 12th dorsal nerve*), *and the upper border of the 2nd lumbar vertebra.*

Here the symptoms are:—Paralysis, not implicating the abdominal muscles, but limited to more or less of those of the lower extremities. No 'girdle sensations' around the trunk. Three superficial reflexes may be abolished, namely, the 'cremasteric,' which depends upon the integrity of the cord in the upper lumbar region; and the 'gluteal' and the 'plantar,' both of which seem to be dependent upon the integrity of the lower part of the lumbar region of the cord. A deep reflex may also be abolished, namely, the so-called 'knee-jerk,' which is dependent upon the upper lumbar region of the cord. 'Ankle-clonus' may be met with when disease affects the upper or mid-lumbar regions of the cord, but not where the lower lumbar region is implicated. Loss of sensibility about the perineum and anus (if not due to disease of nerve-trunks), is indicative of disease of the posterior columns in the lower lumbar region. Absolute paralysis of the bladder and rectum may be present, with tendency to inflammation and ulceration of the former organ.

In the clinical data above given are included the majority of the facts upon which the *regional diagnosis* of diseases of the spinal cord must in all cases be based. In them also will be found the explanations, so far as they can be given in moderate compass, of the *symptoms* met with in different diseases of the spinal cord. An obvious advantage will be found to have resulted from this somewhat lengthy preliminary discussion, if, as it ought to do, it tends to give the practitioner a more thorough insight into the nature and relations of the several diseases of the spinal cord, at the same time that it aids him in their diagnosis.

Although it is true that the groups of symptoms presented in different diseases of the spinal cord, considered individually and collectively, afford the materials upon which a *regional* diagnosis must be founded, it is no less true that a part of the symptomatology (namely, that comprised in the mode of origin and the mode of establishment of the disease, together with what may be gathered from the patient's state generally, from his family history and from his personal history) constitutes the basis upon which a *pathological* diagnosis has to be arrived at. Again, although the arrival at a regional diagnosis is often spoken of, and may seem to be a process altogether distinct from that involved in the arrival at a pathological diagnosis, yet, as a matter of fact, in the investigation of many individual cases of spinal disease, it will be found that the one problem is not settled first, and the other afterwards, but that both are tentatively considered more or less simultaneously. Thus, certain empirically known pathological conditions may afford at once a ready explanation of a given group or sequence of symptoms, as in 'infantile paralysis,' in 'locomotor ataxy,' or, in a more general sense, in angular curvature of the spine. Here, therefore, the pathological diagnosis goes hand in hand with the regional diagnosis, and in working them out each gathers additional confirmation from the establishment of the other. Sometimes, however, as in the case of traumatic injuries (including stabs, and fractures with dislocations of vertebræ), the pathological diagnosis is at once obvious, and the regional diagnosis alone requires to be settled in detail.

For the above reasons it has been necessary to tabulate in this article certain '**Pathological data concerning the Spinal Cord**' (§ 6), though it would not be found specially advantageous were we to follow out this part of the subject further, and attempt here to set down the more general *clinical data and deductions of pathological import*, necessary to be borne in mind for the arrival at a pathological diagnosis, in order to form a series of facts and deductions comparable with those already given in elucidation of the problems of regional diagnosis (§§ 8–11). These other problems will be dealt with, as far as possible, in the descriptions of the several diseases of the spinal cord.

H. Charlton Bastian.

**SPINAL CORD, Special Diseases of.**—In order that the mutual relations of the different diseases of the spinal cord may be the more readily appreciated, their names are here

set down in groups, and they will be severally considered in the same order, which is one based upon their causes and nature, rather than upon alphabetical considerations. This list will, therefore, in addition serve as an index to the present article. The names of the different diseases now to be described are printed in block type; while the names of those diseases which are discussed separately in different parts of the work (to which the reader is referred), are printed in small capital letters.

**I. Diseases of the Spinal Cord dependent upon known organic changes:—**

1. Concussion of the Spinal Cord; 2. Punctured or Gun-shot Wounds of the Spinal Cord; 3. Sudden Crushing Lesions of the Spinal Cord; 4. Slow Compression of the Spinal Cord; 5. Anæmia of the Spinal Cord; 6. Hyperæmia of the Spinal Cord; 7. Inflammation of the Spinal Cord; 8. Hæmorrhage into the Spinal Cord; 9. Softening of the Spinal Cord.

10. INFANTILE PARALYSIS; 11. Acute Spinal Paralysis of Adults; 12. Acute Ascending Paralysis; 13. Chronic Spinal Paralysis; 14. PROGRESSIVE MUSCULAR ATROPHY; 15. PSEUDO-HYPERTROPHIC PARALYSIS.

16. LOCOMOTOR ATAXY; 17. Spasmodic Spinal Paralysis; 18. Amyotrophic Lateral Sclerosis; 19. Multiple or Disseminated Sclerosis.

20. Tumours and New Formations of the Spinal Cord; and 21. Malformations of the Spinal Cord.

**II. Diseases dependent upon unknown or imperfectly known organic changes:—**

22. TETANUS; 23. TETANY; 24. TORTICOLLIS; 25. WRITER'S CRAMP; 26. SPINAL IRRITATION; 27. Reflex Paraplegia; 28. Intermittent Paraplegia; 29. Hysterical Paraplegia; 30. Paraplegia dependent on Idea; 31. Neurasthenia Spinalis; and 32. Toxic Spinal Paralysis.

In addition to these diseases, dependent upon changes limited to the spinal cord, other affections should here be mentioned, in which the spinal cord is implicated (in modes more or less known) together with the cerebrum in one or other of its regions. These *cerebro-spinal* affections are as follows:—1. GENERAL PARALYSIS OF THE INSANE; 2. CEREBRO-SPINAL SCLEROSIS; 3. PARALYSIS AGITANS; 4. HYDROPHOBIA; and 5. CHOREA.

For an account of the diseases dependent upon morbid changes in the membranes of the spinal cord, *see* MENINGES, Spinal, Diseases of.

**1. Spinal Cord, Concussion of.**—SYNON.: *Commotio Medullæ Spinalis*; Fr. *Commotion de la Moelle Épinière*; Ger. *Erschütterung des Rückenmarks.*

ÆTIOLOGY.—This condition is met with principally in persons who have fallen from a height, or in those who have been present in a railway collision. In these cases the brain is apt to suffer as well as the spinal cord, and it is not always easy to unravel the respective symptoms due to shock of this or that great segment of the cerebro-spinal system.

ANATOMICAL CHARACTERS.—In many of these cases there are, in all probability, no morbid changes that would be discoverable. In others, however, minute extravasations of blood, or actual ruptures of the nerve-tissue, may occur—and this sometimes even to a marked extent, as in a case seen by the writer. An example of slighter lesions is recorded by Sir Wm. Gull, in which small extravasations of blood were found in the anterior and posterior cornua as well as in the posterior columns of the cord. In neither of these cases was there any external or visible injury; but in each paraplegia was produced immediately after the fall that determined the lesions in the cord. In addition to hæmorrhages into the substance of the spinal cord itself, there is in these cases the possibility of the occurrence of meningeal hæmorrhages, pressing upon the cord or its nerve-roots; and within a day or two after the occurrence of the concussion itself, there is the possibility of some local and subacute inflammation being set up in the membranes of the cord.

SYMPTOMS.—In the great majority of these cases no complete paralysis is induced, even at first. There may at most be paresis of one or more limbs, general prostration, nausea with occasional vomiting, a rapid and possibly irregular or intermittent pulse (especially after the least exertion), with occasional startings and twitchings of the limbs, whose sensibility may be diminished, exalted, or unaffected. The temperature will probably be at first depressed, as a result of shock, though subsequently a febrile elevation may continue for some days. The tongue may be furred, the appetite bad, the bowels constipated; whilst in regard to micturition there may be either some delay and difficulty, or, on the contrary, an irritability of the bladder, with difficulty in retaining its contents after the desire to micturate is once felt. With this there is often general restlessness, nervousness, and insomnia.

In more severe cases of concussion, even where there is no complication resulting from appreciable lesions, the shock to the system (*see* SHOCK) may be more profound, and there may be paralysis of limbs, lasting perhaps for some days, and then rather suddenly disappearing.

DIAGNOSIS.—The questions to be determined are, whether, looking to the symptoms presented by the patient, there is likely to be any organic lesion or change in the spinal cord or its membranes; or whether we have to do with mere functional perturbations induced by the shock or blow to which the patient has been subjected. In the absence of definite paralysis, or even with its presence for the first few days, the answer to this preliminary question will often be shrouded in doubt. To come to a definite opinion as to the precise nature of the change which a spinal cord, deemed to be damaged in some way after a concussion, has undergone, lapse of time and several examinations of the patient are often required.

In many cases in which compensation for an injury is claimed a further complication appears. Here it is that the difficulty arises as to how much the symptoms experienced, or said to be experienced, may be due to an excited imagination, and how much to causes independent of the imagination, whether voluntarily or involuntarily aroused. It must be conceded that symp-

toms of injury are undoubtedly feigned by unscrupulous persons; and it seems also equally clear that, even unknowingly to the patient, the excitement consequent upon the accident, the details heard concerning the injuries of others, combined with the inquiries of doctors and of sympathising friends, tend to keep up and to exaggerate symptoms in many nervous patients, over and above those which may have resulted from the shock. Such patients also may make a more speedy recovery subsequent to trial and compensation, than they had been making before the trial, and yet they *may* not have been in any sense impostors. It is true that such persons, however, do not recover quite so quickly as those others who for their own unscrupulous ends have been previously exciting their imaginations in a voluntary manner.

Prognosis.—In only the severest cases of concussion or shock is there actual danger to life (*see* Shock). Where, however, great prostration is induced, and especially in those who may previously have been suffering from heart-affections, or from a very excitable nervous system, life may be speedily brought to a close; or at most such patients may not survive a severe concussion more than a day or two.

Severe concussions of the cord may also form the starting-points of many and varied deviations from health, which may not begin to show themselves for weeks, or perhaps even months, after the initial shock. Among such sequelæ, which have come under the writer's notice, may be mentioned the following:—Loss of flesh with general failure of nutrition, epileptiform fits, progressive muscular atrophy, lateral sclerosis of the spinal cord, a slowly increasing paraplegia (of uncertain pathological basis), and caries of vertebræ followed by angular curvature and paraplegia.

In other and slighter cases, time and rest, with suitable medical treatment, may be expected to lead to perfect recovery, sometimes speedily, but sometimes only after protracted periods of impaired health.

Treatment.—In the first instance, symptoms of shock have to be combated by the employment of warmth and stimulants. In subsequent stages, rest in the recumbent position must be enjoined for a time. It is of the first importance to make sure that the patient does take complete rest, and is kept free from excitement during the first few days after any concussion accident, and that he gets sound sleep at night, under the influence of bromide of potassium, or of this together with chloral. If the condition of restlessness, with disturbed sleep, can be checked, then a mitigation of other symptoms may be expected to follow. The application of ice to the spinal column may at times be desirable; or pain must be relieved by the subcutaneous injection of small doses of morphia. Later on tonics, with a simple nutritious diet and plenty of fresh air, together with rest, will be needed for the complete restoration of the patient.

**2. Spinal Cord, Punctured or Gun-shot Wounds of.**—Synon.: Acute Traumatic Lesions of the Spinal Cord; Fr. *Plaies et contusions de la Moelle Épinière*; Ger. *Rückenmarkszerreissungen.*

Ætiology and Anatomical Characters.—Punctured or gun-shot wounds of the spinal cord are commonly made with knife, dagger, sword, or bullet.

In each set of cases, the wound in the spinal cord will be associated with perforation or rupture of some of the membranes, and also with hæmorrhage, either between them or into the substance of the cord. The arches of the vertebræ or their articular processes and some of the ligaments connecting them may be more or less damaged, and a wound commonly exists through the contiguous skin and muscles. In the cord itself, there may be either a clean-cut wound through certain of its columns and parts, or a broader crushing lesion. In each case more or less blood may be effused upon and below the cut surfaces of the cord. At later stages, there may be signs of inflammation of the membranes, as well as of local inflammatory softening of the substance of the cord.

Symptoms.—The signs and symptoms consequent upon wounds of this kind are subject to endless variations, in accordance with the different regions of the cord involved, the actual extent of the wound in its substance, and the possible presence of varying amounts of effused blood. These wounds often involve only a portion of the transverse area of the cord. It is indeed in this class of cases more especially that *hemiplegia spinalis* and *hemiparaplegia* are met with. Thus where a unilateral lesion exists in the mid or upper cervical region, both arm and leg are paralysed, so that the state known as *hemiplegia spinalis* is produced; but where it occurs in the dorsal region, the one leg only is paralysed, and we have what is known as *hemiparaplegia.*

The essential peculiarity in the latter cases is that on the side of lesion there is complete motor paralysis in the limbs or limb below; whilst on the opposite side, the limbs or limb, and the trunk up to the middle line, are more or less completely anæsthetic—sensitiveness to impressions of touch, pain, temperature, and tickling being alike abolished.

Other minor peculiarities are these:—On the side of *motor paralysis*, there is also vaso-motor paralysis, which carries with it, as consequences, (*a*) an elevation of temperature (from 1½° to 2° Fahr.), and (*b*) a hyperæsthesia for all modes of sensibility (owing in part to hyperæmia in the limb and cord). Surrounding the body, at the level of the upper margin of anæsthesia on the side of sensory defect, there is usually a narrow girdle of hyperæsthesia; whilst below this level, on the side of the lesion, there is a half band of hemianæsthesia—whose depth varies with the longitudinal extent of the lesion. (The complete zone of hyperæsthesia is probably due to hyperæmia of nerve-roots, and of the grey matter of the cord immediately above the lesion; while the half-zone of anæsthesia is dependent upon destruction of the nerve-roots, and of the spinal cord for a certain extent.)

If bed-sores occur, they are met with on the side of sensory paralysis; whilst in one or two cases signs of a joint-affection (in the knee principally) have occurred on the side of motor paralysis. There seems no reason for expecting

any special muscular atrophy or diminution of faradaic irritability on the side of motor paralysis, except in those muscles whose nerve-supply comes from the portion of the anterior cornua actually destroyed by the lesion. In many cases, especially at first, there is paralysis of the bladder and of the rectum, or there may be incontinence of urine. Later on these troubles tend to diminish. Nothing definite is known in regard to the condition of the skin-reflexes and tendon-reflexes in these states.

Where anomalies exist in regard to the extent of decussation of the pyramids (Flechsig), the above-described effects of unilateral lesions of the cord would also undergo corresponding variations.

In gun-shot wounds, whether occasioned by pistol or rifle, splinters of bone may be depressed at times, so as to compress and irritate the cord, and thus the symptoms may be made to approximate more closely to wounds of the next category.

After a few days the symptoms may be complicated by those of spinal meningitis, or extended by the spread of an inflammatory softening of the cord above and below the seat of lesion.

Diagnosis.—The primary cause of the patient's condition is generally only too obvious. It may be clear that we have to do either with a punctured or with a gun-shot wound in some region of the spine; but subsequently many, and often very difficult, questions require to be solved. It is of first importance to learn whether the cord itself is really damaged, or whether the symptoms are in the main caused by epi-dural or sub-arachnoid hæmorrhages (*see* Meninges, Spinal, Hæmorrhage into). In the former case there will be evidence of complete or partial interruption of conduction in the cord, to or from all parts below the seat of lesion, and not of a mere local implication of nerve-roots. If it seem probable that the cord itself is damaged, we have to determine whether it is completely cut across, or only partially damaged—and if the latter to what extent. These questions must be decided in the main by reference to the signs given in Introduction, § 8.

Should the case be seen for the first time several days after the injury, an exact diagnosis as to the amount of damage to the cord itself is often greatly obscured by the existence then of certain secondary pathological conditions—more especially localised inflammation of the meninges, or secondary inflammatory softening, extending perhaps above or below, or in both directions, from the original wound. A process of softening may also extend transversely through the whole substance of the cord, even where only a unilateral lesion had previously existed.

Prognosis.—This, as a rule, is bad in all cases of traumatic injury of the spinal cord; and the gravity of the case is usually the greater the higher the wound happens to be situated in the cervical region. Wounds of the dorsal or lumbar region of the cord are rather less serious, so far as life is concerned.

The degree of recovery from paralysis of limbs will greatly depend upon the nature and extent of the wound. A clean-cut wound may be filled up by the growth of a kind of cicatricial tissue; but it has not yet been accurately determined whether the nerve-substance of the cord can be reproduced in man. There seems, however, reason for supposing that some amount of reparation of nerve-tissue may take place in the cut spinal cord even of man—especially in early life.

Treatment.—Absolute rest, with cold applications, and possibly local blood-letting, will be needed in the first instance.

Subsequently, when immediate danger from shock and from the spreading of local inflammation has passed away, the patient must be treated upon the general principles applicable to all cases of paraplegia—which principles will be found set forth in (9) **Spinal Cord, Softening of.**

**3. Spinal Cord, Sudden Crushing Lesions of**; Fr. *Compressions brusques de la Moelle Épinière*; Ger. *Rückenmarksquetschungen.*

Ætiology and Anatomical Characters.—The above form a class of wounds sufficiently distinct to need separate treatment. This kind of damage to the cord may be produced by the sudden giving-way of a carious vertebra in any part of the spinal column; more rarely from a heavy blow on the back, which does not fracture the spine; or, in a modified form, from the bursting into the spinal canal of an aortic aneurism, after its erosion through the vertebræ. But in the majority of cases such wounds of the spinal cord are the results of forms of external violence which cause fracture and dislocation of vertebræ, in some portion of the spinal column between the upper cervical and the upper lumbar region. When this occurs displacement of vertebræ, even to a slight extent, especially in the dorsal region, in which the spinal canal is narrowest, is sufficient to produce severe pressure upon, or crushing of, the spinal cord. The membranes may not be torn across, but the substance of the cord itself may be greatly compressed or reduced to a blood-stained semi-fluid mass of pulp. After some hours there are obvious signs of a commencing inflammatory reaction in the membranes; and above and below the seat of lesion similar changes are apt to be set up in the spinal cord itself, which may go on to the production of a variable amount of inflammatory softening. The patient may die, however, before any of these latter changes have been established.

Symptoms.—These vary much, according to the region of the cord involved. Still, in spite of differences thus dependent upon the seat of injury, there is a certain general similarity in the symptoms produced by all crushing lesions of the spinal cord. They are usually of this nature:—Complete paralysis, both motor and sensory, of parts below the seat of lesion; in addition to severe pains in the back, girdle pains surrounding the body at the upper limit of sensory and motor paralysis; increased heat or possibly undue coldness of the body throughout the paralysed parts; complete paralysis of bladder with retention of urine, gradually giving place to incontinence; paralysis of intestine, extremely obstinate at first, but subsequently complicated with involuntary evacuations after

the administration of purgatives; extinction of all reflex actions at first.

In the course of two or three days, if the patient should survive, other general symptoms become well-marked, owing to the establishment of a local meningitis, together with some amount of traumatic myelitis. Amongst these we have general fever, with an increase of the 'girdle sensation,' and of pains in the limbs; twitchings in the limbs or in particular muscles; and also a general increase in reflex actions for a time.

The above-mentioned complicating pathological processes may gradually subside, but there will still be danger to life from the supervention of severe cystitis or of extensive bed-sores, together with one or other of the various sequelæ to which such conditions are apt to give rise.

The additional symptoms and variations met with, according as the crushing lesion occurs in different regions of the cord, are as follows. (They increase in number the higher the lesion occurs in the spinal cord. *See* Introduction, § 11.)

When it is situated in the *lumbar swelling* we have, in addition to the limitation of the paralysis to the lower extremities, and a more or less complete extinction of related reflex actions, the appearance of rapid atrophy in the paralysed muscles, together with the manifestation of the electrical 'reaction of degeneration.' The bladder and rectum are apt to be completely paralysed.

With the lesion in some part of the *dorsal region* we have sensory and motor paralysis of the trunk up to a certain level, with an absence of the rapid atrophy and before-mentioned electrical reaction in the muscles of the lower extremities, though some atrophy and the presence of this reaction may occur in one or more of the trunk muscles. In addition (and notably with the lesion in higher parts of the dorsal region) there may be some weakness of voice, some interference with the movements of respiration (especially with those of expiration), as well as marked and continuous priapism. The superficial and deep reflexes may be depressed or exalted, according to the condition of the grey matter below the seat of lesion.

With the lesion in the *lower cervical region* the upper extremities are partly paralysed, both as regards sensation and motion; the movements of respiration are much more gravely interfered with (expiration especially), whilst inspiration is of a purely abdominal type; the voice is notably weak and feeble. Continued erection of the penis is more frequently met with; and in some cases a remarkable hyperpyrexia supervenes, in which the temperature before death may rise to 108°–112° Fahr. Should death not occur in this way, it is very apt to supervene in the course of a few days, by gradual failure of respiration, which grows worse than it was in the early days of the affection, owing to the secondary myelitis which becomes established, implicating the cord and nerve-roots at a level higher than the original wound. The pulse is often much interfered with, but variously; it may be slower or much more frequent than natural; it may be small, irregular, and frequent; or full, regular, and infrequent in its beats. There may also be signs of paralysis of the sympathetic vaso-motor nerves supplying the neck and head, perhaps to a more marked extent on one side than on the other.

Where the lesion occurs in the *upper cervical* region of the cord complete paralysis of the trunk and of all four extremities may be recognised, if death does not occur too suddenly to allow even this to be observed. The sudden death, so apt to occur in these cases, is due to the fact that in them the diaphragm is paralysed as well as the other respiratory muscles. Where the lesion does not involve the whole of the roots of the phrenic nerve, and where the shock has not been too abrupt and violent, life (with extremely difficult respiration and almost complete loss of voice) may be prolonged for a few hours.

An admirable series of cases illustrating these crushing injuries to the spinal cord is to be found in Ollivier's work (3me ed., t. i., p. 253 *et seq.*).

Diagnosis.—If the existence of fracture and dislocation of vertebræ can be substantiated, the probabilities are always in favour of the presence of a crushing lesion in the spinal cord. Otherwise after a very severe fall or blow upon the back, doubts may be at first entertained as to whether we have to do with the effects of concussion alone, or with this *plus* some amount of crushing of the cord or of hæmorrhage upon or beneath its membranes. The subsequent course of the symptoms may, however, in a day or two, enable us to resolve these doubts.

Prognosis.—The prognosis in lesions of this kind, as already indicated, is much graver than in the case of mere punctured wounds of the cord—these being oftener slight and partial in their transverse extent. Death may occur immediately; or at any time during the first week; in the main from failure of respiration and of the heart's action. It is only in exceptional cases, and where the lesion is in the dorsal or lumbar region, that life is prolonged for several weeks or months. Such lesions are probably too severe to admit of anything like thorough repair with proper nerve-tissue. Paralysis, therefore, of a more or less complete kind, is lasting. But even where life is prolonged for a few months, it is ultimately lost, owing to the establishment of sloughing bed-sores and ulcerative cystitis, followed perhaps by blood-poisoning, extensive meningitis, or other complications.

Treatment.—In many of these cases treatment is useless and death inevitable. In those which are of a less urgent nature, the possibility (faint though it may be) of bringing about some slight relief by trepanning, with the view of elevating any depressed fragments of the vertebral arches, should not be lost sight of. Except, indeed, for the fact that parts surrounding the cord are damaged, so that rest in one position is often indicated, the treatment of these cases after the first urgent symptoms have abated does not differ from that which is appropriate in other well-marked cases of paraplegia, where there is a tendency to the formation of sloughing bed-sores, and to the establishment of cystitis. *See* (9) **Spinal Cord, Softening of.**

**4. Spinal Cord, Slow Compression of.**

Synon.: Chronic Traumatic Lesion of the Spinal Cord; Fr. *Compression lente de la Moelle Épinière*; (in part) *Paraplégie douloureuse des cancéreux*; Ger. *Langsame Compression des Rückenmarks.*

Ætiology and Anatomical Characters.—The most frequent causes of the set of symptoms grouped under this head are to be found in diseases of the vertebræ, and especially simple inflammatory or scrofulous caries of the bodies of the vertebræ (leading to *angular curvature*, or 'Pott's Disease'). Still, other kinds of disease of the vertebræ may also be productive of slow compression of the spinal cord, and of that form of localised softening of the organ which is so commonly met with in this class of cases (the so-called 'compression myelitis'). Among these may be mentioned *cancer* of the vertebræ, either primary or secondary; also *exostoses* projecting into the spinal canal, or more irregular thickening of the bones in this situation. In cases of vertebral caries, a tough, yellow, scrofulous growth often infiltrates the posterior vertebral ligament, and thence spreads to the dura mater, here producing thickening and irregular fungosities which may press injuriously upon the spinal cord—more especially upon its antero-lateral columns. In these cases the organ may be distinctly softened opposite, and perhaps for a very short distance above and below, the site of compression. At first such softening is principally apparent in the columns above mentioned; but in cases of longer duration it may involve the whole thickness of the cord, and be followed by the usual ascending and descending 'secondary degenerations (§ 6, [13]).' The softened matter itself is an almost bloodless fluid or semi-fluid pulp, either of a whitish or dull yellowish-white colour, and there is generally no undue vascularity of the immediately adjacent portions of the cord.

In certain cases of slow compression no such softening of the cord is produced; there is rather a slow atrophy or disappearance of the nerve-substance as the pressure increases, together with a sclerosis of what remains. This may occur, for instance, where the cord is pressed upon by some exostosis, or by irregular growth and thickening of the inner surface of the spinal canal, such as occurs occasionally in one or other of the cervical vertebræ.

It has long been known that no constant relation exists between the amount of angular curvature and of paralysis in different cases of vertebral caries. Paralysis may be absent where curvature is most marked. On the other hand, with no curvature and with only a slightly marked projection of one or two vertebral spines, paralysis may yet exist to a well-marked degree. This is due to the fact, that in such cases the cord is only very rarely compressed by the bones, whilst it is frequently more or less pressed upon by the yellowish growths which protrude from the inflamed or carious vertebræ, or which produce thickening and infiltration of the dura mater at the seat of disease, and changes of this sort may be well-marked even where no angular curvature is appreciable.

Again, where angular curvature is present, the posterior surface of the bodies of the vertebræ, corresponding with the angle, is often bent, rough, and eroded, and the cord over it is apt to become softened, though there may be no compressing growths or thickenings of the membranes.

Thus it happens that the paralysis in these cases may be variously produced. And seeing that it is often due to pressure by inflammatory products rather than to pressure or irritation from the diseased bones themselves, we may the better understand the fact that occasionally a great improvement may set in and become established in regard to the paralysis, although the angular curvature of the spine, and therefore the distortion of the spinal canal, remains as obvious as it ever has been.

In addition to slow compression of the cord resulting from diseases of the bones of the spine, a somewhat similar condition may be induced by the various kinds of tumours of the meninges, or by hydatid growths implicating these parts (*see* Meninges, Spinal, Diseases of; Tumours). Confined within the narrow limits of the spinal canal, such tumours, even though of small size, may soon come to exercise a very injurious amount of pressure upon the spinal cord.

Symptoms, Course, and Terminations.—We shall point out some of the distinguishing characteristics of the paralysis which is often associated with vertebral caries, and afterwards refer to the peculiarities met with where meningeal tumours exist.

In *vertebral caries* with commencing pressure upon the spinal cord, the symptoms will be different, according to the part of the column implicated. The affection is frequently ushered in by an abiding pain in the spine and parts adjacent, often supposed to be 'rheumatic' in nature. Such pains commonly disappear when the patient is in the recumbent position, except during the acts of sneezing or coughing. They are commonly induced by particular kinds of movements, which are more or less difficult on this account. There is also some weakness in the lower part of the body and in the lower extremities. The mere 'weakness' may continue for weeks or even months before there is anything like actual paralysis; though at last this may show itself somewhat abruptly. The patient now becomes unable to stand, though he can still move his legs slightly whilst lying in bed. At this stage sensation is little, if at all, interfered with; but there may already be some increase in the readiness with which the knee-reflex manifests itself, and ankle-clonus may also be easily attainable. Next there may be startings of the limbs, and commencing rigidity of the muscles when passive movements are attempted; followed after a time by a more marked rigidity (which, when present in the calf muscles, will prevent the manifestation of ankle-clonus and of the knee-reflex). Later, if pressure increases, and especially where a complete transverse softening becomes established, sensibility in its various modes becomes implicated. At this period the exaltation of the reflexes often diminishes. For a time the degree of impairment of sensibility and the freedom with which knee-reflex and ankle-clonus may be obtained fluctuates. Meanwhile, painful spasmodic contractions of the legs

(with flexion of hip and knee joints) become habitual, persisting through day and night with only rare intermissions.

Although there is some general wasting of the muscles, together with a flabby condition when they are relaxed, they still react almost normally to the faradic current. The skin is often dry and scurfy. The temperature of the limbs is generally slightly lower than normal.

At the first onset there may be for a few days a difficulty in voiding the urine, but this power soon returns and often continues long after the limbs have become powerless. The bowels are perhaps somewhat constipated, but there is no incontinence of fæces, unless diarrhœa supervenes from any cause, or except when the reflex activity of the bowel is greatly exalted under the influence of aperient medicines.

The above condition of things may last long without much variation. But after a time there will be a gradual mitigation of the symptoms, or the reverse. In the latter case loss of voluntary control over the bladder and rectum appears; and (especially when sensibility of the body and limbs becomes impaired) the tendency to the formation of sloughs and gangrenous bed-sores becomes increased. With these conditions other complications, such as cystitis, blood-poisoning, &c., may appear and greatly aggravate the condition of the patient, helping to bring about a more speedy termination.

In the case of *tumours arising from the meninges*, the onset of the affection may also be very gradual at first, though, perhaps, rather suddenly intensified at last. Here, however, the pressure very often comes upon the cord from behind, or it may at the same time implicate one or both lateral regions of the cord. At first, therefore, we commonly get variously-impaired sensibility and neuralgic pains, or pains mixed with startings and cramp-like contractions in certain muscles, occurring in those particular regions of the body or limbs which are in relation with the nerve-roots slightly pressed upon and irritated by the new growth. Great differences exist in different cases in regard to the degree and persistence of the initial pains. Subsequently these same nerves and the cord itself may become more severely pressed upon, and then loss of sensibility over the field of distribution of the nerve-roots is met with, together with loss or impairment of sensibility in all or some parts of the body whose nerve-supply is from the cord below the compressed region. With this a minor amount of motor paralysis also occurs, which, however, subsequently becomes more marked, and ultimately complete. When this takes place we have all the signs and symptoms met with in a case of total transverse softening of the spinal cord at the level implicated (*see* **Spinal Cord, Softening of**). This change is, in fact, commonly established by the persistence and increase of pressure due to the new growth.

These are the broad outlines of the symptoms met with in such cases, which, of course, are subject to innumerable variations in individual cases, in accordance with differences in the region of the cord affected, together with the rate of growth, mode of incidence, and size of the tumour.

In *cancer of the vertebræ*, also, we have much the same grouping of symptoms; the preliminary pains being here especially severe (*see* Charcot's *Leçons*, t. II., ed. 3, p. 86).

Diagnosis.—In the paralysis associated with *vertebral caries* the diagnosis depends upon the recognition of this causal condition, which, in the early stages, is often a matter of some difficulty. Much will depend upon the existence of pain in particular regions of the spine, or radiating therefrom; of pain which is relieved by the recumbent position, and greatly aggravated by coughing, sneezing, or stooping movements of different kinds (see H. Marsh in *Brit. Med. Journ.*, vol. i. 1881, p. 913). And yet in the absence of signs of caries, or of a scrofulous habit of body or history, or of an exciting cause for caries, in cases where there may be little or no prominence of vertebral spines, and even no pain from firm pressure or the application of a hot sponge, we may be helped in our diagnosis of the existence of caries by the distinctive characters of the paralysis itself, namely, its implication of motility principally, the exaggeration of the tendon-reflexes, the more or less marked rigidity of the legs, and the continuance of control over the bladder and rectum.

In cases of the latter type, or where there is only a slight prominence of two to four vertebral spines, it may be difficult, however, to establish a diagnosis between caries and *cancer* of the bodies of the vertebræ. It is true that a rounded prominence of several vertebral spines is met with in cancer more frequently than the angular projection commonly associated with caries; yet this single character will not always aid us; we must look also to the presence or absence of severe pains, to the clinical grouping of symptoms generally, and to the history of the patient.

The diagnosis of the other causes of slow compression of the cord to which reference has been made (exostoses or meningeal tumours), is usually a matter of extreme difficulty. We must be guided by probabilities based upon other associated states or conditions that may be recognisable in our patient, and also by the mode of onset of the affection.

Prognosis.—We can only speak in general terms concerning the prognosis of the rather miscellaneous conditions which form the subject of this article. Cancer of the vertebræ or of the dura mater, compressing the cord, is the most serious of them all. The progress of such cases is usually both rapid and extremely painful, so that the end comes inevitably before many months have expired.

In vertebral caries associated with compression of the cord, the prognosis is extremely uncertain. Under suitable treatment many of these cases practically recover more or less fully. The process of caries is arrested, the spoiled vertebræ are strengthened and bridged over by growth of new bony tissue (though, of course, the angular curvature of the spine remains), whilst recovery from the paralysis may be more or less complete. This latter kind of recovery takes place occasionally even after paralysis, with almost persistent contractions of the lower extremities, has existed for from twelve to eighteen months or even longer.

In other cases, of exostosis, hydatids, or meningeal tumours, compressing the spinal cord, the prognosis will depend upon the part of the cord involved, upon the rate of increase of the symptoms of compression, and upon the extent to which a secondary myelitis or softening is established. The disease in these cases, in spite of stationary periods, or even those of slight improvement, is more or less continuously progressive, though it may last for many months, or, occasionally, even for a year or two. Some of the complications or accidents incident to the paraplegic condition ultimately bring the patient's life to a close.

Treatment.—Rest in the recumbent or in the prone position is, of course, absolutely essential in cases of vertebral caries or of cancer of the vertebræ. In addition to this in many cases of vertebral caries, some form of Sayre's jacket may be needed, in order more effectually to secure absolute immobility of the affected portion of the spinal column. This, however, would have to be reserved for the more chronic cases or stages —for those in which local treatment was no longer considered to be necessary or desirable.

In cases of paraplegia associated with vertebral caries, the patient's general health requires the utmost attention during the period in which we are endeavouring to check the disease by the influence of rest. Good nutritious food and cod-liver oil will be required, combined with steel wine or the syrupus ferri phosphatis. In some cases iodide of potassium (together with iodide of iron or small doses of bichloride of mercury) seems to do good.

In regard to local measures, counter-irritation of some kind is generally had recourse to, either in the form of flying blisters near to and on each side of the portion of the spinal column which is affected, or else by the renewed application of moxas or the actual cautery to these regions. The latter more severe measures are still recommended by some authorities, though the experience of others, amongst whom was the late Sir Benjamin Brodie, is against their employment, as being of little or no use, and therefore adding needlessly to the sufferings of the patient. The writer is strongly inclined to think that all the good which moxas or the actual cautery are intended to bring about, may be as effectually achieved by the aid of flying blisters applied to the spine from time to time.

In the case of an hydatid tumour pressing upon the spinal cord, and also situated in part outside the vertebral spines, tapping might bring much relief. In the majority of the other conditions comprised within the limits of this article, little can be done to cure the condition which is the cause of the spinal disease, so that it would only remain for us to treat the paraplegia and its attendant conditions upon the general principles applicable to them, which are fully considered under (9) **Spinal Cord, Softening of.**

**5. Spinal Cord, Anæmia of.**—Anæmia is not to be considered as the basis of any ordinary or common disease of the cord; or, in other words, there is no definite group of symptoms the existence of which is likely to be recognised more than once in a lifetime in any actual present patient, which would justify the diagnosis 'anæmia of the cord.'

First, the writer would repudiate the notion that *anæmia* or *chlorosis*, as a mere blood-disease, is capable of producing, on the side of the spinal cord, any set of symptoms which can be marked off from those characterising the condition as a whole. In these diseases the functions of all the organs are impaired by reason of the impoverishment of the blood. The brain and spinal cord, on account of the delicacy of their functions, will, of course, suffer to a notable degree; and when general debility is extreme, a paresis of the lower extremities may be notable beyond that of other parts of the body, because the legs in standing or in walking have to support so great a weight. Where anything more than such paresis exists—that is, where there is actual paraplegia, such symptoms are not to be explained by a mere anæmia of the cord. Other causes are to be looked for. Jaccoud's whole group of *paraplégies dyscrasiques* will probably disappear before a more thorough knowledge of the actual mode of causation of these and many other obscure forms of paraplegia.

Secondly, *embolism* and *thrombosis* of spinal arteries will produce temporarily, and in quite limited regions of the cord, a condition of anæmia. Such local anæmia would probably soon be rectified by the establishment of a collateral circulation; and in the event of this not taking place, local 'softening' of the organ would ensue. A paralysis owning such an origin would not, therefore, be spoken of as resulting from 'anæmia of the cord.'

Thirdly, *pressure* upon parts of the cord will occasion anæmia and ultimately softening, but the symptoms in a case of this sort will depend mainly upon the pressure itself interfering with the functions of the nerve-tissue thus affected.

Beyond the conditions above referred to, there is the possibility that definite groups of paralytic symptoms may be occasioned by anæmia induced by mere functional *spasm of the arteries* in certain regions of the cord—spasm, that is, which persists day after day. This is supposed by Brown-Séquard to be the condition existing in the cases of so-called 'reflex paralysis' (*see* 27, **Reflex Paraplegia**). If such a condition of persisting arterial spasm be possible, and an actual cause of paralytic symptoms, we may well ask whether it too ought not after a time to lead to actual softening of the cord.

There will still remain a very few exceptional cases, in which a condition of real anæmia of the spinal cord is brought about in man, just as it has been brought about in some of the lower animals whose abdominal aorta has been tied or compressed. When the blood-supply is thus suddenly cut off from the lumbar region of the cord in animals, their hinder limbs become paralysed almost immediately, and continue paralysed as long as the blood-supply of the cord happens to be arrested. But if, after a mere brief interval, the blood is again allowed to take its natural course, the temporary paralysis disappears completely in a very short time. A condition of this kind seems to have occurred in a patient, formerly under the care of Sir W. Gull, who suddenly became paraplegic, apparently owing to an abrupt arrest of

the blood-current through the abdominal aorta, as was indicated by the cessation of the femoral and other pulses in the lower extremities (see *Guy's Hospital Reports*, 1857, p. 311). The man continued paraplegic for months, and only recovered when the collateral circulation became, after a time, pretty fully established. In a very few other cases referred to by Erb, in which paraplegic symptoms were associated with an obstruction of some kind in the abdominal aorta he thinks that these symptoms, supervening as they did rather less suddenly, may have been in great part due to the deficient blood-supply to the muscles and nerves of the lower extremities, rather than to anæmia of the cord—to a peripheral, that is, rather than to a centric anæmia.

**6. Spinal Cord and its Membranes, Hyperæmia of.**—This condition again is more frequently talked of than it deserves, looking to the small amount of positive knowledge we possess upon the subject.

Hyperæmia of the cord must be either passive or active, that is, it must be a result of *mechanical congestion* or of *arterial determination*.

*Mechanical Congestion.*—In obstructive heart-disease extreme congestion of the spinal cord may exist for months without producing any distinct symptoms of disease of the spinal cord. A constantly congested spinal cord would doubtless perform its functions in a less vigorous manner than natural, but such effects would be slowly evolved and comparatively obscure. After a long time the effects might become more marked, owing to the overgrowth of connective tissue within the organ. We may indeed have the starting-point of a general sclerosis of the spinal cord under such conditions; but this secondary change, when only slightly marked, may, even in the spinal cord, produce no definite symptoms.

General mechanical congestion of the cord is probably more frequent and more easily brought about than a congestion involving parts of the organ. From various causes there may be undue pressure upon certain veins, which directly or indirectly convey blood away from special regions of the cord and its membranes. Such an event cannot, however, be regarded as a likely cause of a congestion productive of morbid spinal symptoms, if we consider the absence of distinct symptoms resulting from extreme general congestion of the cord; and also the fact of the very free anastomosis of all the spinal veins.

*Active hyperæmia* may in its origin be of two kinds—'reflex' or 'inflammatory.'

'Reflex' hyperæmia of the cord and its membranes is possibly a phenomenon of great frequency, manifesting itself locally in certain regions—the seat of the process varying according to the conditions under which it arises. It might be immediately caused by vaso-motor paralysis, implicating certain vessels of the cord and their branches; and would thus involve an increased afflux of blood to the tissues contained in the corresponding vascular territories. We know that such an increased afflux of blood may exist in other tissues for some time without inducing tissue-changes of an appreciable kind (Brown-Séquard). It is fair to suppose, moreover, that any symptoms induced by such increased afflux of blood to certain regions of the cord would be indicative of exalted rather than of depressed function (for example, hyperæsthesia, actual pains and spasms, or increased reflex excitability, rather than their opposites).

In weak and irritable states of the nervous system it is quite possible that such vaso-motor paralysis, and also vaso-motor spasms inducing localised anæmias, may manifest themselves in spinal vessels, as they do in cutaneous vessels by familiar flushes or pallors. If occurring in the skin, however, these would be temporary phenomena, and not capable of producing the symptoms of an abiding disease. How frequent such reflex local hyperæmias (whether brief or prolonged) may be in the spinal cord, and in what precise manner they are excited, we do not know. Suppression of the menses or of hæmorrhoidal fluxes, the presence of worms in the intestine, the prolonged incidence of cold and wet, or severe concussions of the spine, any or all *may* operate in this particular manner—but for proof that they do, as matter of fact, we may look for evidence in vain.

The subject of 'inflammatory hyperæmia' will be briefly considered under the next heading. In this case, in addition to changes in the vascular system, the effects of the inflammatory process as a whole have to be taken into account. Even in the first stage of inflammation something prior to and beyond the mere 'active' congestion has to be thought of.

From what is said above, it may be seen how shadowy is our present knowledge concerning the existence of any definite sets of symptoms which can be ascribed to non-inflammatory hyperæmia of the cord and its membranes, either general or local.[1]

**7. Spinal Cord, Inflammation of.**—Synon.: Myelitis; *Myelitis Acuta*; Softening of the Spinal Cord (in part); Fr. *Myélite*; *Myélite aiguë*; *Inflammation de la Moelle Epinière*; *Ramollissement de la Moelle Épinière* (in part); Ger. *Myelitis; Rückenmarksentzündung*; *Erweichung des Rückenmarks* (in part).

Nature, Ætiology, and Pathology.—To speak definitely on this subject, in the present state of knowledge, is extremely difficult. This is due to several causes. In the first place, it is owing to the fact that so much uncertainty exists in the minds of many eminent pathologists and physicians as to what ought rightfully to be included under this term; and, secondly, because by a very large number of writers the term is understood and used in the vaguest

[1] The view in regard to congestion as a cause of definite morbid symptoms on the side of the brain and of the spinal cord has been entertained for the last sixteen years at least by the present writer, and the above article (6) has been *in manuscript* for nearly three years. It seems necessary for him to make this statement to prevent further misunderstanding arising from the fact that his name appears as one of the authors of a paper on 'Congestion of the Brain,' in Dr. Reynolds's *System of Medicine*, in which a much more important *rôle* is attached to Congestion as a producer of definite morbid symptoms. The present writer was, however, only the author of the sections on 'Pathology' and 'Morbid Anatomy' in the above-mentioned article, and was not, previous to its publication, aware of the views entertained by the accomplished editor of the work in question in regard to the supposed great clinical significance of Congestion when it exists in the brain.

manner, but with a manifest tendency to comprise under it the largest possible number of affections of the spinal cord. Critical discrimination seems to have been, and still to be, in abeyance with many who describe or report cases of disease of the spinal cord. They set down as instances of 'myelitis' not only all cases in which the substance of the spinal cord is softened, but still more all those in which it is indurated—and, no less impartially, those in which it is merely degenerated.

(1) The notion that common 'softenings' of the spinal cord are of inflammatory origin has persisted with little alteration, although for nearly twenty years pathologists have been interpreting altogether differently the mode of production of apparently similar 'softenings' of the cerebrum and cerebellum. Can it be that 'softening' as it occurs in the majority of cases in these latter organs is of non-inflammatory origin; while in the majority of apparently similar cases occurring in the spinal cord, the process is really inflammatory in its nature?

(2) Then, again, without adequate cause, the very localised changes occurring in and around the great ganglion-cells of the anterior cornua, in 'acute' and 'chronic spinal paralysis,' and in 'progressive muscular atrophy,' have been set down as inflammatory in their nature, and new names have been given to these affections, tending to ratify this view as to their origin. Thus they are spoken of by some as cases of *anterior polio-myelitis*, or more briefly, and, so far, better, as cases of *cornual myelitis*. But localisation of an inflammatory process to great ganglion-cells and their immediate surroundings, at present constitutes a rather unintelligible process to many pathologists. And mysterious as these particular changes are, from the point of view of their ætiology, on any hypothesis that has yet been started, it is at least simpler, and more harmonious with the nature of the observed conditions themselves, to regard them as of a degenerative type. If the slower and more isolated changes characteristic of 'progressive muscular atrophy,' are to be placed in this category (and in regard to them there is absolutely no evidence either clinical or pathological that can be adduced in favour of an inflammatory origin), then also it becomes easy to believe that under some at present imperfectly defined conditions, a change of the same kind may set in more rapidly in these the most specialised of all the anatomical elements met with in the spinal cord, so as to produce the more acute affections above referred to. The slight secondary overgrowth of neuroglia often occurring around the degenerated ganglion-cells, does not in the least militate against this view as to the pathology of the process; a similar secondary change occurs also in the process next to be referred to, and will be found to be easily explicable without the necessity of having recourse to the ever-ready and fashionable hypothesis of inflammation.

(3) 'Secondary degenerations' of the spinal cord have indeed, in spite of their name, and of what is known as to their origin, been erroneously regarded of late by some writers as inflammatory changes (Ziemssen's *Cyclopædia*, vol. xiii. p. 769). When nerve-fibres are cut across, those portions which are severed from their connection with certain ganglion-cells are no longer able to preserve their nutritive integrity. Simultaneously throughout their whole length fatty degeneration affects their white substance. Myeline breaks up, and becomes disintegrated as it does in non-inflammatory softenings in the brain; and very speedily granulation-corpuscles begin to form abundantly throughout the changing area. But though fatty degeneration thus occurs simultaneously in all the cut fibres of the band, the vascular supply of this tract of tissue has not been altered. Since the blood in the diseased area is not utilised by the nerve-tissues proper, except to a very small extent, a large excess of nutriment is placed at the disposal of the neuroglia, and this undergoes a well-marked hyperplasia. Thus a band of tissue-change is produced in which some of the characteristics of softening are blended with those pertaining to a patch of sclerosis. In brief, we have effects resulting from a primary fatty degeneration of the nerve-fibres, and a secondary hyperplasia of the neuroglia; and from first to last there is not the least reason for believing in the existence of an inflammatory process.

(4) If we turn now to 'sclerosis' of the cord of primary origin, we again meet with processes which are commonly regarded and described as forms of '*chronic myelitis*.' This nomenclature is objectionable as applied to the processes in the spinal cord, just as it is in its application to like processes occurring in other organs, as the liver, the lungs, or the kidneys. Fibroid overgrowth, which forms the basis of so many examples of 'cirrhosis' or 'sclerosis' in different organs and tissues of the body, is a process pathologically intermediate between inflammation, on the one hand, and degeneration on the other. Thus, what were formerly named 'interstitial inflammations,' are now the 'non-inflammatory hyperplasias' of some pathologists, and the 'fibroid degenerations' of others. It would seem that the view as to the inflammatory nature of such processes is erroneous, if we look either to what is known concerning their modes of initiation, or to the actual nature of the changes themselves (which agree in every particular with those of infiltrating new growths); it would seem, moreover, not less erroneous if we look to the clinical history of the affections themselves in which these scleroses occur. It conveys, therefore, an altogether erroneous implication to speak of such mere fibroid overgrowths as so many instances of 'chronic myelitis.'

Thus, it will be seen that the writer attributes to inflammation a far more restricted *rôle* in the production of morbid conditions of the spinal cord than is customary. The various forms of so-called 'chronic myelitis' he would exclude from that category. He would do the same for the set of changes known as 'secondary degenerations'; and also for those which are characterised by more or less acute atrophic processes implicating the great ganglion-cells of the anterior cornua.

Of the processes above referred to in order, there remains, therefore, only the class of 'softenings' of the spinal cord. That many of these

are of a simply degenerative type (due to disturbances of blood-supply), and that, in the great majority of cases, these are the instances in which 'softening' appears to occur as a primary process, the writer feels assured. On the other hand, it seems clear that in many cases changes, truly inflammatory in their origin and progress, may terminate in the production of states of 'softening' of the cord, which are indistinguishable by naked eye from the softenings of degenerative type, and which can as yet also be very imperfectly discriminated by the microscope.

These latter *inflammatory softenings* very rarely occur as primary pathological states; they are met with rather as *secondary* changes.

Thus we may get inflammatory softenings spreading (*a*) around and from wounds or other traumatic lesions of the spinal cord; or (*b*) starting from some blood-clot or tumour situated in or pressing upon the substance of the cord. It is not by any means clear, however, that all the forms of softening which arise in the latter manner should be regarded as of an inflammatory nature; and much room for doubt also exists as to the real pathogenesis of many cases of so-called 'compression myelitis' (p. 1471).

Another cause of true inflammatory changes in the spinal cord (*myelitis peripherica*) is to be found (*c*) in spinal leptomeningitis (*see* MENINGES, SPINAL, Diseases of; *Leptomeningitis*).

Suppuration is clearly a process of inflammatory origin, and might therefore be expected to occur occasionally in the midst of 'softenings' which result from inflammation. In the light of what has been said above, the following statement by Erb is of considerable interest. 'Actual suppuration occurs very rarely,' he says, 'in acute myelitis. When abscess of the cord does form, it is generally secondary to a severe traumatic lesion or to suppurative meningitis. In spontaneous myelitis, on the other hand, suppuration is exceedingly rare, and has only been observed in a very few cases.' Thus suppuration is met with just in those forms of softening ('myelitis') which are undoubtedly of inflammatory origin; and, on the other hand, it is not met with in the ordinary cases of primary or spontaneous softening, here assumed to be of non-inflammatory nature.

In instances other than those above mentioned, suppuration rarely occurs in the spinal cord. Small disseminated abscesses may, however, be found in pyæmic cases, as they are in the brain and in other organs.

One other condition requires to be referred to here, and that is the so-called *acute central myelitis*, described originally by Albers, and afterwards studied by Hayem (see *Archives de Physiologie*, 1874, p. 603). These are cases in which apparently spontaneous 'softening' is met with, implicating in the main the central grey matter, and that often through a considerable extent of the cord. At times, however, the softening extends beyond the grey matter, so as to involve more or less of the surrounding white substance, when it has been termed *myelitis diffusa*. Considerable obscurity still prevails in regard to the ætiology of these affections. In some cases, such a change has been met with as part of an infective process, in which minute vessels in the grey matter of the cord have been found obstructed with micrococci. Occasionally, moreover, in certain at present imperfectly known conditions, minute thromboses may, as Dr. J. Hamilton has shown, occur throughout the spinal cord, and more especially in its grey matter, and thus lead on in the main to the production of a central softening (see *British and Foreign Review*, April 1876, p. 447). In this latter case, the patient was suffering from pyelitis, and it is supposed that there may have been some blood-poisoning. Still it was not ascertained that the multitudes of minute thrombi were either associated with or caused by micrococci in the vessels. It appears probable, however, that if from any cause minute widespread obstructions of small vessels occur in the spinal cord, softening would take place principally in the grey matter, owing to its greater vascularity. We should thus get that particular distribution of this change which is met with principally in cases of so-called 'acute central' or 'diffuse myelitis.'

A careful study of the two cases of this disease recorded by Hayem has by no means sufficed to convince the writer that they ought to be regarded as having had an inflammatory origin. Neither the symptoms nor the mode of onset of the disease lend any distinct support to this view; nor do the results of the elaborate examination, to which the spinal cords were submitted by this accomplished observer, at all satisfy the writer that the pathological conditions met with were inflammatory either at their commencement or in their subsequent progress. *See* **Spinal Cord, Softening of.**

SYMPTOMS, COURSE, AND TERMINATIONS.—From what has been said it will be seen that true inflammatory conditions of the cord are only with extreme rarity of primary origin, and that they occur, for the most part, as secondary complications in association (*a*) with wounds or injuries of the cord; (*b*) with foreign bodies in its substance; or (*c*) with spinal leptomeningitis, either simple or tubercular.

The supervention of a real myelitis in the course of either of these diseases of the spinal cord would perhaps be associated with an exaggeration of the already existing febrile condition; with an increase in the amount of paralysis, and in the degree of interference with sensibility; possibly also with more pain, restlessness, and spasms.

Myelitis may become associated with more or less of distinct suppuration, and almost certainly goes on to the formation of well-marked foci of softening. These may remain limited in site, but occasionally they have a distinct tendency to spread above and below the original seat of injury or disease. Such dépôts would probably undergo subsequent changes, very similar in kind to those prone to occur in foci of non-inflammatory softening.

DIAGNOSIS.—All that can be said under this head has been referred to above in connection with the symptoms characterising the supervention of myelitis.

PROGNOSIS.—The gravity of any wound or lesion of the spinal cord, or attaching to the presence in it of blood-clot or tumour, is, of course, greatly

increased by the supervention of inflammatory changes about their immediate confines. Again, the fact that an inflammation of the spinal meninges is complicated with similar changes in the substance of the spinal cord itself, cannot fail greatly to aggravate a case of simple spinal leptomeningitis. For, even should recovery from the acute affection take place, the actual degree of abiding paralysis, ataxy, or impairment of sensibility would much depend upon the degree in which the substance of the spinal cord had been itself implicated.

Treatment.—The amount of power that we possess in controlling an inflammatory condition of the spinal cord is probably not great. Little if anything is at present to be done with mere drugs. The patient should, if possible, lie in the prone position, or, failing this, on his side, with absolute rest. The advisability of abstracting blood locally by cupping or leeches should be entertained, and must depend much upon the amount of local pain or tenderness. In some cases it seems to be of service. Or we may trust rather to the application of cold externally, in the form of ice-bags, along the spine. At the same time the patient should be kept upon spoon diet, with a sparing amount of stimulants; and the bowels should be relieved by the aid of copious warm enemata, which may also act usefully as derivatives. The limitations circumscribing our efforts at direct therapeutics must be compensated as far as possible by attention to the state of the general health, and by the most careful and assiduous nursing, in the hope that the morbid process may after a time abate, and that, in the absence of collateral complications, the patient may make a more or less complete recovery.

8. **Spinal Cord, Hæmorrhage into.**—Synon.: *Hæmatomyelia; Hæmatorrhagia Medullæ spinalis*; Spinal Apoplexy; Fr. *Hématomyélie; Apoplexie de la Moelle Épinière; Des hémorrhagies intrarachidiennes*; Ger. *Rückenmarksapoplexie; Spinalapoplexie.*

Ætiology and Anatomical Characters.—Hæmorrhage into this organ is a comparatively rare event. It occurs under three different conditions, namely—(1) as a result of concussion or violence; (2) as a secondary event, consequent upon a definite pre-existing morbid condition; and (3) as a primary event, or local pathological accident.

We are here specially concerned with hæmorrhages into the spinal cord belonging to the third of these categories, and may in a few words dismiss the other two.

(1) Traumatic hæmorrhages, small in extent, may, as already stated, occur in almost any region or part of the cord as a result of some severe concussion (*see* **Spinal Cord, Concussion of**). Again it may occur in the grey matter, and even in the white substance to a smaller extent, close to and as an appanage of wounds of the cord. In each of these cases symptoms due to the hæmorrhage itself would probably be obscured by the general set of symptoms resulting from the concussion or injury.

(2) Secondary hæmorrhages are, however, more closely connected, from the point of view of symptomatology, with those forming the special subject of this article. During the growth of certain soft tumours in the cord, a rupture of some of their vessels may take place, so as to cause hæmorrhage either into the growth itself, or else into contiguous regions of the cord. Such an event would be signalised clinically by the sudden exacerbation of the symptoms previously existing. But a combination of greater importance, though one of considerable obscurity, consists in the co-existence of a 'central myelitis' of the grey matter of the cord through more or less of its extent, together with a central hæmorrhage of nearly similar extent. The existence of any such 'central myelitis' as an independent disease of the cord seems to the writer very doubtful. It is at least equally probable that the hæmorrhage has been primary, and that the 'myelitis' or softening is of secondary origin around the blood-clot. It need not be denied, of course, that in other cases hæmorrhage does occur occasionally into the midst of a focus of softened tissue in the spinal cord, just as it occurs occasionally under similar conditions in the midst of softened brain-tissue.

(3) Primary hæmorrhages differ as regards the amount, the site, and the distribution of the blood effused, in different cases. In connection with scorbutic states, and also independently of these, small hæmorrhages may occasionally occur into the substance of the cord, without producing any distinct symptoms. But, at other times, a comparatively large quantity of blood may be effused into the cord, and then it occurs almost invariably into the central regions of the grey matter, through which it may extend for a variable distance. When the quantity is smaller, the blood may be effused into the grey matter of one side only.

Though this kind of hæmorrhage is, in contradistinction to the others, spoken of as primary, yet it is almost invariably preceded by some pathological changes in the vessels of the cord. These constitute the predisposing conditions, and the actual rupture takes place, rarely, when the person is at rest, or, more frequently, under the influence of some distinct exciting cause—such as muscular exertion of one kind or another.

Primary hæmorrhage, though rare, is most prone to occur in persons between the ages of twenty and forty, and not with increasing frequency as age advances. This constitutes a further notable difference between hæmorrhages into the brain and those of the spinal cord.

Symptoms.—These are necessarily subject to great variations, according as the hæmorrhage takes place into the cervical, the dorsal, or the lumbar region. The kind of variation thus induced may be gathered by reference to the Introduction, § 11.

Here it is of importance to set forth the peculiarities (both as regards mode of onset, and nature of the symptoms) which belong to hæmorrhage as compared with other pathological conditions of the cord. First, its tendency is to take place suddenly and without warning; and, secondly, for the blood to be effused into the grey matter for some distance, thus giving rise to a characteristic grouping of symptoms. There may, therefore, be a sudden onset of pain in the back (possibly severe); followed almost immediately

by complete motor and sensory paralysis of the legs and trunk up to a certain level, together with complete paralysis of the bladder and rectum. At first there may be an abolition of all reflexes, and possibly a lowering of temperature in the legs; though after a day or two—should the injury be in the dorsal or lower cervical region of the cord—there may be increased heat of legs, owing to vaso-motor paralysis, and a return with some exaggeration of various reflexes. Rapid atrophy, with the appearance of the electrical 'reaction of degeneration,' occurs in all muscles that are in immediate functional relations with the portions of the cord damaged. Cystitis, together with sloughing bed-sores and all their consequences, tend to occur early, and that often in spite of all precautions that may be taken.

Where the hæmorrhage invades pretty fully, but is limited to, the grey matter of one half of the cord, we may have groups of symptoms that take the form of *hemiplegia spinalis* or *hemiparaplegia*. *See* (2) **Spinal Cord, Punctured or Gun-shot Wounds of.**

Diagnosis.—The absolutely sudden onset of the paralysis, which may be complete in the lower extremities in the course of a few minutes; (especially when associated with a sudden painful sensation in the back, or one which radiates into the limbs); as well as the almost complete and sudden loss of sensibility in the paralysed parts, form a group of symptoms which are typically distinctive of hæmorrhage into the grey matter of the cord.

The condition most likely to be confounded with it is a large *hæmorrhage outside the dura mater*, causing compression of the cord. Here the onset would also be sudden, but almost invariably associated with some mechanical injury or shock. The paralysis of motion too would generally be much more marked than the interference with sensibility. The subsequent progress of such a case would further tend to separate it from a case of intra-medullary hæmorrhage, since (even with a severe meningeal hæmorrhage in the cervical region) if the patient should survive the first effects of the lesion, the symptoms might be expected soon to grow less and less urgent, and recovery may be more or less complete. No such amelioration is, however, to be expected in the case of a well-marked hæmorrhage into the grey matter of the cord, in the cervical region or elsewhere.

On the side of the brain *embolism* is capable of initiating paralytic symptoms with as much suddenness as a hæmorrhage, but in the spinal cord, for reasons previously stated, this does not occur (see Introduction, § 6 (8)).

It does, however, happen occasionally that a process of softening—probably caused by *thrombosis*—has its occasioning conditions initiated suddenly. When this occurs paraplegia sets in almost as abruptly as if it were occasioned by hæmorrhage; but then it is usually an incomplete paraplegia, and, for a time at least, unaccompanied by loss of sensibility. In the course of a few days, in such a case, sensory paralysis may supervene, and the motor paralysis may become more complete. In the exceptional cases of paraplegia of sudden onset due to this cause, there is generally no initial pain in the back, though there may be pains and burning sensations in the limbs.

Prognosis.—Where the hæmorrhage is at all large, so as to extend through the grey matter for the distance of an inch or more, the prognosis is always grave. Very few of such cases recover. They are, in fact, liable to be aggravated by the establishment of a secondary process of softening in the grey matter, which may slowly extend both above and below the blood-clot as well as around it. Should this softening reach far into the cervical region, or should the hæmorrhage itself implicate this part of the cord, the patient may not survive more than a few days. But if the primary and secondary pathological changes are limited to the lumbar or to the dorsal region of the spinal cord, the fatal event is usually brought about more slowly, after an interval of weeks or perhaps even of months—and then commonly from the occurrence of sloughing bed-sores, together with cystitis and other accompaniments of a severe paraplegia.

In the case of small hæmorrhages limited to some fractional part of the transverse area of the cord, and of slight longitudinal extent, the prognosis is of course much more favourable, and there is no reason why partial recovery, at least, may not occur.

Treatment.—In the treatment of a case of spinal hæmorrhage, should the patient be seen immediately after its occurrence, absolute quietude, with rest in the recumbent or prone posture, should be ensured.

Bleeding, either local or general, is useless. Purgatives also are contra-indicated.

Should the pulse be full, and the heart's action excited, decided benefit may be derived from ten-minim doses of tincture of digitalis, in combination with 15 or 20 grains of bromide of potassium, given for the first three doses at intervals of three or four hours, and subsequently every six or eight hours for two or three days. These drugs will also favour sleep, and exercise a general calmative influence.

Position and rest are perhaps the means to be principally relied upon to prevent a recurrence or continuance of the hæmorrhage; such measures may be supplemented by warm applications to the feet and calves of the legs; though the patient should in other respects be kept perfectly cool. Ice to the spine may be applied, but is of doubtful utility. Spoon diet should be strictly enjoined for a few days at least.

The patient's urine will require to be drawn off by catheter, and extra precautions ought to be taken to ensure its antiseptic cleanliness. After a day or two, if the bowels have not been moved, a laxative should be administered, since, as in many other forms of paraplegia, there may, at first, be obstinate constipation rather than incontinence of fæces.

Subsequently, the case requires to be treated in all respects like any other very bad case of paraplegia—extra precautions being observed throughout, in order, as far as possible, to guard against the onset of bed-sores and cystitis. Fuller details concerning such treatment will be found under the next article, **Spinal Cord, Softening of**, since this is by far the most common cause of paraplegia.

9. **Spinal Cord, Softening of.**—Synon.: Non-inflammatory, white, or simple softening; *Myelomalacia*; *Mollities Medullæ spinalis*; Acute Myelitis (in part); Compression Myelitis (in part); Fr. *Ramollissement de la Moelle Épinière*; Ger. *Erweichung des Rückenmarks.*

Nature of Change.—The writer has already intimated (*see* Myelitis) his opinion that far too large a share is assigned to inflammation in the pathogenesis of diseases of the spinal cord. This mistake is particularly obvious in regard to acute inflammations. It has long been the fashion to speak of almost every focus of 'softening' that occurs in the spinal cord as being the result of an 'acute myelitis'; and we find even Erb (in Ziemssen's *Cyclopædia*, vol. xiii.) putting forward, as characteristics of an inflammatory softening, peculiarities which certainly ought not to be regarded in such a light—and this although he seems otherwise strongly inclined to hold a similar opinion to that above expressed. Whilst admitting that a true myelitis is not distinguishable macroscopically, in the great majority of cases, from a simple or non-inflammatory softening, Erb adds a statement to the effect that the 'microscopical examination can alone furnish conclusive evidence.' In the opinion of the writer, however, such evidence as that which is cited by Erb (*loc. cit.* p. 470) is quite inconclusive.

It is evident, indeed, that we are still almost as destitute of microscopical as we are of macroscopical characters, of a trustworthy description, for enabling us to decide whether any given focus of softening has been of inflammatory or of simple non-inflammatory origin. Such researches as those of Hamilton (*Quart. Journ. of Micros. Science*, Oct. 1875) and others must be prosecuted further and multiplied before any certain means of deciding such a question will exist.

In the present state of knowledge, therefore, it would appear that the 'non-inflammatory softenings' of the cord are represented by the primary and apparently idiopathic 'softenings' which frequently occur in this organ.

Ætiology and Pathogenesis.—Concerning the ætiology of non-inflammatory softening of the spinal cord, it is impossible to speak positively. The disease presents itself as a spontaneous or idiopathic affection, sometimes without apparent cause or definite antecedent conditions of any kind, but at others as a sequence of one or other of various known and common antecedent conditions.

Thus in certain cases the symptoms set in more or less suddenly after some great bodily fatigue; in others after extreme sexual excesses; or they may occur during the period of convalescence from certain acute fevers, such as variola, typhus, and other exanthemata, or after rheumatic fever. During the first week or two after childbirth there is likewise a liability to such symptoms; and also in the later stages of syphilis. These different conditions may act very variously in contributing to bring about a focus of softening in the spinal cord, and nothing more than conjectures can be advanced in regard to its pathogenesis in the several cases.

Again, the symptoms indicative of a primary softening of the cord may set in after the action of other conditions, regarded by some as exciting rather than as predisposing causes. Of these the following may be enumerated:—Prolonged exposure to cold and wet; sudden suppression of the menses or of other accustomed fluxes; violent emotional disturbances; or the existence of some inflammation in one or other of the pelvic organs, such as the uterus or the bladder and urethra (instances of the latter class being some of the cases formerly supposed to be of 'reflex origin). In regard to these 'exciting causes,' all that is certainly known is, that softening of the cord seems to set in not unfrequently in persons who have been subjected to one or other of them; but in what precise mode either of them is related to the subsequent softening, nothing very definite can be said. Something, nevertheless, may be advanced by way of suggestion—with the view more especially of giving some direction to the investigations needful for clearing up this subject.

Spinal and cerebral softenings probably own a similar mode of origin. Of the obstructions of vessels which so largely determine cerebral non-inflammatory softenings, it is those due to thrombosis rather than to embolism which intervene in the main for the production of corresponding conditions in the spinal cord (*see* Introduction, § 6, (8) and (9)).

It is well known that the causes of thrombosis are principally three, and that in different cases, now one now another of them may be most influential; whilst in other instances two or more of these causes may co-operate. These three causes are (*a*) thickenings, irregularities, or degenerations of the inner coats of the vessels; (*b*) slowness of blood-current; (*c*) peculiarities in the chemical composition of the blood, rendering it more than usually prone to coagulate.

The thrombosis may take place in the arteries or in the veins, and the plexiform arrangement of the spinal vessels which exists, together with the slowness of their blood-current, may favour the occurrence, as well as the spread of the process when it has once been initiated. Thus a process of coagulation, beginning, perhaps, in some very small vessel, may gradually extend so as to involve larger and larger branches, and thereby increase the area of the cord which is deprived of its proper blood-supply. And it is especially worthy of note, in this connection, that the blood-supply of the lower end of the cord (where primary softenings are most common) is peculiar and easily interfered with. To this important point Dr. Moxon has recently called attention (*Brit. Med. Jour.* vol. i., 1881). In short, the anatomical conditions existing in the cord, both on the arterial and on the venous side of its circulation, are probably of a kind distinctly to favour the occurrence of thrombosis; and, if there were space for it, we might attempt to show something as to the respective modes of action of the very different exciting and predisposing causes which have been previously enumerated, as seeming to be in relation with primary softening of this part of the nervous system.

Anatomical Characters.—In regard to their distribution or extent in the cord many varieties of softening exist. These have been commonly recognised, though they have been mostly de-

scribed under corresponding designations as so many varieties of 'myelitis.' Thus, we may have a 'complete transverse softening,' involving the entire thickness of the cord for a variable longitudinal extent, either in the lumbar, the dorsal, or in the cervical region. Or the softening may be more limited to certain subdivisions of the cord in one or other of these regions—and then constitute an 'incomplete transverse softening.' Thus it may, in one set of cases, principally affect the anterior columns and grey matter; in another set the posterior columns and more or less of the grey matter. Or the softening may be central, and almost confined to the grey matter through a considerable extent of the cord, as in 'diffuse central softening;' when this change involves the white columns as well as the grey matter for a considerable extent, we have what is called 'diffuse softening' of the cord. When a small focus of softening exists which only involves part of the transverse area of the cord, and that for a very limited extent, we have a 'circumscribed softening' of the cord; and where many of these small foci are scattered through different parts and regions of the organ, we have what is known as 'disseminated softening.'

An accidental damage during the opening of the spinal canal must not be confounded with the results of pathological change. In a spinal cord bruised in the manner indicated the nerve-substance may be softened and diffluent, and somewhat resemble a patch of real pathological softening. Examination with the microscope, however, would show, amongst the fragments of myeline from the broken nerve-tubules in the former case, an entire absence of the large granulation-corpuscles, which are, on the contrary, invariably present in a patch of real pathological softening. If there were, after such an examination, still room for doubt, this might be resolved by the fact that the softened nerve-matter in a patch of real softening of the cord, has its specific gravity lower by 3–5 degrees than that of other healthy portions of the organ, whilst in the patch of merely bruised nerve-substance it would not be appreciably lower than normal. The normal specific gravity of the spinal cord varies commonly from 1033–1041 in different individuals—the higher figures being most frequently met with in elderly persons. The modes of estimating the specific gravity have been discussed by the writer in *Journ. of Ment. Science*, vol. xi. 1866.

Where the process of softening has gone on to its final stages—in a case, for instance, of 'complete transverse softening'—the whole substance of the cord in the affected site is reduced to a rather dirty-looking milky fluid, which, when the membranes are cut across, flows out so as to leave a complete gap in the cord-substance for an extent, it may be, of one to three inches.

Symptoms, Course, and Terminations.—The symptomatology of this disease presents an extremely wide range, in accordance with the varying extent and sites of the softening in the cord, as existing in different patients.

In 'circumscribed' and 'disseminated softening,' for instance, the symptomatology would be excessively variable in different patients, and, especially in the latter class of cases, it might be extremely difficult to arrive at a diagnosis. The symptoms could, in fact, only be interpreted by the light of the general principles applicable to the regional and pathological diagnosis.

Again, in cases of 'diffuse central softening' the symptoms—except for the fact that they set in gradually rather than abruptly—would bear a close resemblance to those of hæmorrhage into the spinal cord, where the blood is effused into the central grey matter for a certain extent (*see* No. 8, **Spinal Cord, Hæmorrhage into**). There is some doubt, indeed, whether these latter cases may not occur principally as epiphenomena sequential to a primary central softening.

The symptomatology of 'incomplete transverse softenings' of the cord, is for the most part exemplified by the second stages of various forms of so-called 'compression myelitis'—cases, that is, in which the anterior regions of the cord more especially are, in one set of cases, principally pressed upon either by tumour, or by the inflammatory products associated with vertebral caries ('Pott's Disease'); whilst in another set the posterior columns and posterior grey matter may undergo a similar softening, under the influence of the pressure of a new growth impinging upon the cord from behind. Cases of this type, however, may easily and do often merge into 'complete transverse softening' (commonly known as 'complete transverse myelitis'). Both complete and incomplete forms also often occur in the cord, quite independently of pressure.

Of these states it will be well, for the sake of brevity, to confine our attention principally to '*complete transverse softening*.'

In a case of *complete transverse softening* involving the mid-dorsal region, the temperature in the axilla usually varies between 98° and 100°F., though with an extension of the pathological process, or towards the close of the disease, it may rise to 101°, 102°, or even higher. Meanwhile the lower extremities themselves are often distinctly cold to the hand—the temperature being in some cases more or less subnormal. It is important to note this, because it might have been supposed that hyperæmia and a slightly elevated temperature would exist, owing to the vaso-motor nerves of the limbs being paralysed.

The motor paralysis of the lower extremities is absolute, and the abdominal muscles are also powerless. The feet, as the patient lies in bed, are extended and often inverted, so that the great toes cross one another. The skin after a time tends to become dry and scurfy. The muscles feel flabby to the hand, but they waste only to a slight extent, and continue week after week to show only a small amount, if any, of diminution in the degree of their irritability to faradaic and to galvanic currents.

The sensibility of the limbs is completely abolished both for tactile and painful impressions, as well as for differences of temperature and tickling. A like abolition of sensibility exists over the trunk up to the level of the 'ensiform area' whilst above this level the sensibility becomes quite natural. Though the upper limit of anæsthesia may be quite sharply defined, yet in these cases of complete transverse softening there is often no distinct 'girdle-sensation.'

The muscles of the lower extremities may show some slight irritability when they are forcibly tapped, and when the soles of the feet are strongly tickled there may be very slight movements of the toes; but beyond this there is often an entire absence of all reflex movements—there is no ankle-clonus, no knee-reflex, and a similar absence of the cremasteric and abdominal reflexes.[1] In the initial stages of the affection, however, and especially when the softening is not completely transverse, all these reflexes may be extremely well-marked for a time, though they tend gradually to diminish.

For the first ten days or a fortnight there is often complete retention of urine, but after this time, when the lumbar region of the cord again becomes capable of manifesting to some extent its centric functions, the initial retention gives place to incontinence of urine. This fluid may be discharged at intervals of two to three hours in small quantities, owing to the occurrence of reflex contractions of the bladder whenever it attains a certain degree of fulness. The passage of a catheter, however, in these cases will often show that the bladder is never completely emptied—two to four ounces remaining after the reflex contractions. Unless special precautions are taken, the urine, in such patients, speedily becomes ammoniacal, and more or less loaded with mucus.

The bowels are usually constipated, and relieved only after the administration of aperients or enemata. At these times there is generally incontinence of fæces—the patient having no power of controlling the reflex actions concerned in defæcation when they have once been strongly excited. The actual passage of the motion is moreover often unfelt.

Under the irritative influences emanating from the seat of softening during the period of its establishment, a small bed-sore may begin to form, often amenable to treatment. Later on, sloughs are apt to form upon the heels, over the malleoli, and in other situations habitually exposed to continuous pressure. But the most frequent site for intractable sloughing bed-sores is over the sacrum. Inflammation of the mucous membrane of the bladder is at last set up; and the inflammation may extend up one or both ureters, so as to implicate the pelvis of the kidney, when minute abscesses may also form in the kidney itself.

Under the influence of these various conditions the patient's appetite and strength gradually fail; emaciation proceeds; and death after a time may come from sheer exhaustion, aided, perhaps, by some intercurrent inflammatory affection of the lungs. Other modes of death are pointed out in the section on Prognosis.

Diagnosis.—The recognition of this disease at the bedside often presents considerable difficulties. We must be guided partly (*a*) by the patient's history and state; partly (*b*) by the mode of onset of the disease; and partly (*c*) by the symptoms of the fully established affection.

(*a*) The points in regard to previous history which are of principal significance are referred to under the head of Ætiology. In regard to (*b*) mode of onset, this is usually not abrupt and sudden; there is rather a slow increase of paralysis during a week, ten days, or a fortnight. Still, it is a fact that softening of the cord (apparently due to thrombosis) does occasionally cause a sudden incomplete paralysis, though such paralysis increases subsequently in the manner above stated. Such a case must not therefore be confounded with hæmorrhage into the cord, merely by reason of its absolutely abrupt onset.

The extent to which the diagnosis turns upon (*c*) the nature of the symptoms of the fully-established affection, cannot be very definitely defined except in some cases. When the softening is slight and partial, it gives rise to no distinctive symptoms; but where there are clinical signs of the existence of a complete transverse lesion, the chances are that the lesion itself is, if not a primary, at all events a secondary softening.

In regard to the regional diagnosis of softening of the spinal cord, the following points require to be borne in mind:—

The indications as to the transverse area involved, and as to the upper limits of the change in the spinal cord, are wholly derivable from the presence or absence of the various signs and symptoms which have been set forth in the Introduction, § 8, (*a*), and § 11.

The attempt to ascertain the lower level of the lesion, and consequently its longitudinal extent in the cord, is always difficult, and often cannot be achieved with any success. The indications are all obscure, uncertain, and apt to fail. This is especially the case if we attempt to base an opinion on the fact of the existence or absence of superficial reflexes (*see* § 5, (*a*)). Thus, complete transverse softening may exist in the upper dorsal region, and extensive secondary degenerations may have been produced, yet for week after week there may be a complete absence of all the reflexes (superficial and deep) dependent upon the cord below the upper dorsal region. This the writer has lately ascertained by repeated clinical examinations of cases whose nature has been subsequently verified *post mortem*.

Prognosis.—The prognosis in a case of paraplegia must always involve a twofold problem:—(1) as to the duration of paralysis, or the probability of recovery; (2) as to the danger to life.

(1) The chance of ultimate recovery from paralysis would vary inversely with the size or extent of the lesion existing after the first ten days or a fortnight—that is, by the time softening has been unmistakably established, and when the chance of such an event being warded off by the establishment of a collateral circulation no longer exists. But where a reinstatement of blood-supply does take place, all symptoms of paralysis may gradually disappear in the course of some weeks, or, it may be, months.

(2) Danger to life is brought about in many ways, and a fatal result may be entailed (*a*) by a gradual extension upwards of the process of

[1] In one recent case in which paraplegia had existed for over three months, in consequence of a complete transverse softening in the upper dorsal region (with the above-mentioned clinical signs), the writer was much struck with the extremely pallid appearance of the grey matter through the whole length of the cord below the seat of softening. The absence of the reflexes may be in part due to such condition of the grey matter, and this itself may be caused by a spasm of its vessels in some way induced by the lesion above. Some amount of spasm may also exist in the vessels of the limbs, whose temperature is often rather sub-normal.

softening (especially where it exists in the lower cervical or upper dorsal region) so as to involve paralysis of the diaphragm, or an extreme interference with the heart's action. (*b*) Inflammation of the bladder, followed by implication of other portions of the urinary tract, may lead on to death after the paralysis has lasted for some months. (*c*) About the same period extensive bed-sores may form, and the patient may, after a time, die exhausted, or from blood-poisoning. (*d*) The supervention of an intercurrent pneumonia may lead on to a fatal result; or (*e*) the end may come from the extension inwards of the process of sloughing, so as to lead to the establishment of a rapidly fatal spinal meningitis. Still, in some cases the patient may remain paralysed for a very long time before a fatal termination is brought about.

Treatment.—Our power to deal with the softened condition itself of the spinal cord is extremely small, whether it may have been caused by thrombosis or by compression. During the early stages probably the less that is done in the way of active interference the better. The principal indications are that the patient should have absolute rest in bed, and for the first few days at least a rather sparing diet; spoon diet being desirable where distinct elevation of temperature exists. The secretions should be regulated, and the urine, if necessary, drawn off by a thoroughly clean catheter smeared with carbolised oil. Sedatives, such as bromide of potassium, either alone or in combination with chloral, may be needed at night, for a time, so as to ensure sound and refreshing sleep.

Should the patient's general health be weak or deranged, as is so often the case, every effort must be made to improve it by means of an easily assimilated but generous diet, gradually increased, and by the exhibition of suitable tonics, with or without small doses of cod-liver oil. It is far better to trust to such general means than to the supposed influence of phosphorus, or any other drug. To expect any of them to have a direct influence in restoring softened nerve-tissue is vain; and any good that may be achieved by drugs alone is probably brought about either by their power of regulating some of the principal functions of the body, or by improving its nutritive processes generally.

Still scarcely any morbid condition exists in which more constant care and vigilance are needed than in the *paraplegic state*, in order to correct or ward off its numerous incidental troubles or complications.

One of the first points claiming attention in the early stages of a case of paraplegia is to take such measures as will stave off the occurrence of bed-sores as long as possible. These precautions are especially needful where the paraplegia is complete, and where loss of sensibility exists. The patient should at an early stage of the disease be placed upon a water-bed; and those forms are most suitable in which there is a canal through the centre for the passage downwards of the evacuations. The patient must be kept scrupulously clean and dry; and no folds of the bed-clothes must be permited to press against the skin. If possible, the patient should not be allowed to lie habitually upon his back, but occasionally in a prone or lateral position. The skin over the sacrum especially must be carefully watched, and on the least sign of a patch of undue redness there, it should be rubbed once or twice a day with a mixture of equal parts of olive-oil and spirits of wine. If it becomes actually abraded it should be dressed with zinc ointment, smeared over a piece of soft lint.

For the first fortnight or more there may be complete retention of urine, which then requires to be drawn off night and morning by catheter. During this period great care should be taken in regard to the cleanliness of the catheter employed, and only instruments which have been smeared with carbolised oil should be used. Carelessness in this respect will tend to bring on cystitis at an early date, with alkalinity of urine, and may thus quite prematurely aggravate the bladder-troubles. As soon as the bladder begins to empty itself again, in a reflex manner, at intervals throughout the day, the use of the catheter may be discontinued as long as the water which comes away continues to be clear and acid. During this period of incontinence it will be necessary to draw off the urine from time to time for the purposes of examination. As before stated, the bladder never completely empties itself. After this state of things has continued for some weeks, the urine at last generally becomes alkaline, ammoniacal, and more or less mixed with mucus. At this stage the bladder should again be emptied once or twice daily, and washed out each time with 6 to 8 oz. of quinine solution (2 grains to the ounce, with enough of dilute sulphuric acid to dissolve it); or with a 1–2 per cent. solution of the new drug, 'resorcin.' This will prove the best means of warding off or of mitigating inflammation of the bladder; and thus perhaps of preventing its extension to the ureters and kidneys.

In regard to the bowels, purgatives will probably be required from the first, as without their use there will be no evacuation. Sometimes a simple enema will suffice. Scybalæ tend to accumulate in the large intestine, unless its contractility can be aroused occasionally by a large injection, consisting of three pints of warm thin gruel, together with half an ounce of spirits of turpentine and an ounce of castor oil.

Where the disease has reached the chronic stage, and when death is not inevitable, the muscles should be faradised or galvanised three times a week, with a view to maintaining their nutrition, and in old and extreme cases of this sort, good results seem occasionally to have been obtained by passing fine needles through the skin into the muscles, and then connecting these needles, one after another, with the negative pole of a voltaic battery of suitable strength, the positive pole being applied at the same time to the back, or to the limb above the transfixed muscle, by means of a damp sponge, in the usual way. This method, recommended especially by Dr. J. E. Morgan, is only suitable where there is also loss of sensibility.

When in the final stages of paraplegia large and sloughing bed-sores have formed, they will require the most constant care and attention. Poultices may be at first needed till the sloughs

have separated, and afterwards the wounds must be variously dressed according to their condition. An ointment composed of ten grains of carbolic acid to one ounce of vaseline may be employed; or more stimulating applications may be needed. Sometimes the iodide of starch paste forms a suitable dressing.

10. **Infantile Paralysis.** *See* INFANTILE PARALYSIS.

11. **Acute Spinal Paralysis of Adults.**—SYNON.: *Poliomyelitis Anterior Acuta*; Acute Inflammation of the Grey Anterior Horns; Acute Atrophic Spinal Paralysis; Fr. *Paralysie spinale atrophique aiguë*; Ger. *Poliomyelitis Anterior Acuta*; *Acute Spinallähmung bei Erwachsenen.*

This is essentially the same disease as that known as infantile paralysis (*see* INFANTILE PARALYSIS), though presenting certain differences from the fact of its occurring in adults. Its existence, however, was not distinctly recognised till about the year 1865, when illustrative cases were published almost simultaneously by Duchenne and Morritz Meyer. Now that observers have been on the look-out for it, it has proved to be one which is by no means uncommon, although it is very much rarer than the similar affection in infancy or early childhood. The disease is more difficult to recognise in adults, because in them other affections occur with which it is quite possible that it may be confounded.

ÆTIOLOGY.—The ætiology of this affection in adults is just as obscure as it is in children. Sometimes it manifests itself without any assignable cause; whilst at other times there is the possibility that exposure to wet and cold, some shock or blow, or some antecedent acute febrile illness may have had to do with its origin.

SYMPTOMS.—It will principally be necessary in this place to point out the manner in which the group of signs and symptoms characteristic of the disease in infancy becomes modified when it occurs in the adult.

The first set of differences is due to the minor irritability of the nervous system in the adult, as compared with that of the young child. The initial febrile symptoms may be so slight as to escape notice; convulsions have never been met with; and preliminary head-symptoms are generally very slight. Some headache, or mental dulness, may be present; and vomiting occurs not unfrequently.

Paralysis then sets in speedily—it may be within a few hours—and is more or less widespread. The muscles are flaccid; reflex actions are abolished or greatly diminished. In the course of a few days, generally, improvement as regards motor power sets in, and very slowly progresses. It may go on continuously to complete recovery in the course of a few months; or, as often happens, such recovery is only partial. In the latter case certain muscles or groups of muscles remain paralysed, and in them a rapid atrophy occurs. When tested electrically, these muscles exhibit the 'reaction of degeneration.' The affected parts are cold, and sometimes more or less cyanotic. There is no impairment of sensibility; and no interference with the functions of the bladder or rectum.

All the characters mentioned in the last paragraph accord with those which present themselves in infantile paralysis, but later on differences again show themselves. One of the characteristic features in the child is arrest of growth in the parts affected, so that the limbs or parts of limbs paralysed remain more or less abortive. This, of course, cannot occur in the adult; and also owing to the fact that the joints are stronger, the secondary deformities (often so serious in the child) are not met with to the same extent in adults.

PROGNOSIS.—This is not a disease dangerous to life. Complete recovery not unfrequently takes place, and that too, as the writer has recently seen, where the paralysis may have been widespread, affecting all the limbs for a time, and leading to marked atrophy in the muscles of the lower extremities. In other cases, there is left in particular parts a chronic remainder of paralysis with atrophy, just as we find to be the case in children.

DIAGNOSIS.—The mode of origination of the disease; the fact that the paralysis is purely motor, and accompanied by no interference with sensibility; the fact that after the first few days at least the functions of the bladder and rectum are not interfered with; and also that in later stages there is atrophy of muscles, and the existence of the electrical 'reaction of degeneration'—these constitute a group of conditions which, taken as a whole, is thoroughly distinctive.

The disease with which it is most liable to be confounded is that about to be described, namely, (13) **Chronic Atrophic Spinal Paralysis.** The points of distinction will, therefore, be given under it. 'Progressive muscular atrophy,' if we bear in mind its very chronic onset, is much less liable to be confounded with the present disease, as also if we recollect that in it atrophy makes its appearance before paralysis rather than after, and that the electrical reactions are notably different.

The fact of the absence of spasms, the diminution of reflexes, the non-interference with sensibility and with the sphincters, together with the abrupt origin of the disease, suffice to separate the acute spinal paralysis of adults from all other affections of the spinal cord.

TREATMENT.—This disease must be dealt with on precisely the same principles as those which are applicable to the corresponding affection in young children. Repetition is, therefore, here unnecessary. *See* INFANTILE PARALYSIS.

12. **Acute Ascending Paralysis.**—SYNON.: *Paralysis Ascendens Acuta*; Landry's Paralysis; Fr. *Paralysie ascendante aiguë*; Ger. *Paralysis ascendens acuta.*

DEFINITION.—A mysterious affection of the spinal cord, first definitely described by Landry in 1859; characterised on its clinical side by the existence of a progressive paralysis, advancing rapidly from below upwards, so as finally to implicate parts dependent for their innervation upon the medulla oblongata; characterised also on its anatomical side by the most puzzling absence of any appreciable pathological change.

On account of the latter peculiarity, the disease ought not to be described in the present place, but rather to constitute the first of Class II.

But this disease, together with 'acute spinal paralysis' and 'chronic spinal paralysis,' have such an amount of similarity from a clinical point of view, that it seems very desirable for their descriptions to follow one another, so that mutual alliances as well as differences may be the more distinctly appreciated.

Ætiology and Pathology.—The causes and pathogenesis of this affection are just as obscure as those of the disease last referred to. Exposure to cold, and emotional disturbances (with or without suppression of menstruation in the female) have been observed occasionally as precursors. Occasionally, too, this disease has supervened during convalescence from some previous acute febrile malady. Syphilis is thought by a few (but on no sufficient evidence) to have something to do with the pathogenesis of this affection. Westphal, again, is inclined to believe in the possibility of some toxic influence—though this also is little more than a mere supposition. The disease seems principally to occur in persons between the ages of twenty and forty, and to be decidedly more frequent in males than in females. Although the brain and spinal cord of those who have died from this affection have now been frequently examined by skilled observers, the results have hitherto been entirely negative, so far as morbid anatomy is concerned.

Symptoms, Course, and Terminations. — About the prodromata there is nothing distinctive—they may be absent. When present there may, for a few days, or even for a few weeks, be a slight febrile condition from time to time, with a sense of weariness, and more or less numbness in the limbs, especially in the tips of the fingers and in the feet.

The disease then more definitely declares itself by a marked weakness of the lower extremities; soon to be followed by actual paralysis, which, as in the 'subacute and chronic spinal paralysis,' shows itself first in the distal portions of the limbs, and gradually approaches the trunk, so that in the course of two or three days the paralysis of the lower extremities becomes complete.

The trunk muscles are next and soon implicated in a similar manner. The patient can no longer sit up or turn in bed. Respiration becomes more and more affected, and defæcation is interfered with, through weakening of the abdominal muscles.

Next, though sometimes after a distinct interval, the upper extremities become implicated; though here again the paralysis first involves the distal portions of the extremities, and thence gradually spreads (after a period in which mere paresis exists), till the whole limbs become completely powerless.

The paralysed limbs, both upper and lower, are lax, and show no trace of contraction. Though the muscles are flaccid, they *do not undergo* a *marked* amount of *atrophy*, as is the case in acute spinal paralysis.'

In accordance with this latter peculiarity, there is the further striking characteristic that the *electrical reactions of nerves and muscles continue perfectly normal.* This seems now to be a well-attested fact, and it has been verified by good observers even after complete paralysis (without atrophy) has existed for several weeks.

Sensibility is scarcely, if at all affected; nor, as a rule, are pains complained of in the paralysed parts.

The nutrition of the skin is not impaired, so that there is no tendency to the formation of bed-sores. Coldness and cyanosis do not seem to be characteristics of this affection.

The sphincters are usually not at all affected. Constipation is often marked, and defæcation may be rendered difficult owing to paralysis of the abdominal muscles.

In regard to reflex actions, these—especially the skin-reflexes—may not be much affected at first, but may be abolished later on. Existing information is defective concerning 'tendon-reflexes' in this affection, and the writer has made no observations on the point himself.

As a rule there is no febrile elevation of temperature.

At the stage above indicated, in nearly one-third of the recorded cases, or it may be even before the arms have become much implicated, the disease becomes arrested, and after a brief interval recovery of power begins to manifest itself—usually in a reverse order, so that power is regained first over the arms, then over the trunk, and subsequently (in the course of several weeks) over the lower extremities.

But in the remaining two-thirds of the cases, after the arms have become paralysed, the disease still progresses so as to affect the cervical muscles, the diaphragm, and finally the muscles innervated by the motor nerves of the medulla. Thus, in its later phases the disease is characterised by a greatly increasing difficulty in respiration; great weakness in voice; extreme rapidity of pulse; and possibly by inequality of the pupils. Finally, increasing paralysis of the muscles concerned with articulation and deglutition sets in; and, owing to the augmenting difficulties of respiration, death may arrive at any moment by asphyxia. This climax of the disease may be reached in the course even of three or four days; on the other hand, it may not be reached until as many weeks have elapsed. Whenever the disease has advanced so far as seriously to implicate the medulla, recoveries are comparatively rare.

In quite exceptional cases the disease may pursue a reverse order throughout; implicating the nerves of the medulla first, then those of the cervical region of the cord, and so on. The celebrated Cuvier is said to have died from the disease, progressing in this very unusual manner.

Prognosis.—Nothing can be added concerning prognosis beyond what has been above indicated in speaking of the course and terminations of the disease. It seems the rule that, the more rapid the progress of the disease, and the earlier the medulla is affected, the more is a fatal termination to be feared. Still, even in the most acute cases, improvement *may* take place.

Diagnosis.—So far as the established disease is concerned, we have in this affection, in 'acute spinal paralysis of adults,' and in subacute forms of 'chronic spinal paralysis' maladies that present certain well-marked points of similarity. In each we have to do with simple motor paralysis, with no fever, no tenderness or pains in the spine, no pains in the limbs or con-

tractions, and with no incontinence of urine or fæces, or tendency to the occurrence of bed-sores.

'Acute ascending paralysis' differs from both these affections, however, in the important fact that rapid atrophy does not set in in the paralysed muscles, and that the electricial reactions in no way differ from those met with in healthy nerves and muscles. In the very acute cases, of a few days' duration only, these distinctions would be worthless, as sufficient time would not have elapsed to make it possible for either of them to occur. In such rapid cases, therefore, the distinctly *progressive* character of the disease is that which will serve to distinguish it from the more severe cases of 'acute spinal paralysis,' in which the paralysis sets in simultaneously throughout the whole of the parts affected, and often with a pretty distinct initial febrile disturbance. Then, again, there is the fact that this latter disease has no tendency to involve the medulla, and is only very rarely fatal.

It is in the diagnosis of the more slowly evolved forms of 'acute ascending paralysis,' from the similarly progressive cases of 'chronic spinal paralysis,' that the development of rapid atrophy of the muscles, together with the 'reaction of degeneration' comes to be distinctive of the latter affection. Then, again, in 'acute ascending paralysis,' there is a longer persistence of reflex actions, and a far greater tendency to the manifestation of symptoms showing that the medulla oblongata is involved.

Treatment.—The absence of any known pathological substratum for this disease makes it extremely difficult to lay down any directions for treatment. It would appear that we have to do with a simple alteration of the molecular condition of the spinal motor nerve-centres, unaccompanied by any known inflammation or irregularity of vascular supply.

Under these circumstances, the patient should be put upon a nutritious but easily assimilable diet, with a fair amount of stimulants; and, further, we may endeavour to induce a change in the nutritive and functional activity of the spinal cord, by having recourse to frictions of the skin or gentle shampooing of the limbs, together with brief daily applications of weak faradic currents to many of the affected muscles.

From drugs, perhaps the best chance of beneficial results may be looked for from combinations of iron and arsenic, or from the cautious use of small doses of strychnia. Iodide of potassium would probably be useless. Sulphur baths should be had recourse to in the more chronic cases.

**13. Chronic Atrophic Spinal Paralysis.** Synon.: Subacute and Chronic Inflammation of the Grey Anterior Horns; *Poliomyelitis Anterior Subacuta et Chronica*; Fr. *Paralysie générale spinale anterieure subaiguë*; Ger. *Subacute Spinallähmung Erwachsener; Subacute Spinalparalysie.*

Nature, Ætiology, and Pathology.—This disease was described by Duchenne in 1853, and then again more completely in 1872, as a more or less rapidly advancing motor paralysis, associated with atrophy of the muscles affected, and loss of their faradic excitability.

He believed the disease to be dependent upon a chronic degeneration occurring in the grey anterior horns, and this view is supported by the few examinations as yet made of persons who have been the subjects of this affection. The pathological changes in the anterior horns have been associated with atrophy of the anterior nerve-roots.

The causes of the malady are at present almost wholly unknown; but it occurs principally in individuals between the ages of thirty and fifty years. As with other chronic spinal affections, so here, there has often been one or other of the following events occurring some little time before the onset of the disease:—Exposure to cold and damp, some shock or concussion, venereal excesses, or great fatigue induced by other causes. But what share the pre-existence of one or other of these conditions may have had in initiating the disease cannot at present be defined.

Symptoms.—In the subacute cases, paralysis may become developed (usually in the lower extremities first) in the course of a few days or weeks; at the same time there may be some very slight initial febrile disturbance, and possibly some shooting pains in the back and limbs.

In the more chronic cases, the latter symptoms may be absent, and the onset of paralysis is very much slower. There may be at first mere paresis, felt most in the ankles and knees; but gradually (often after many months) this deepens into distinct paralysis of certain groups of muscles, or of the entire limbs. The muscles are flabby and progressively waste; at the same time they cease to respond well or even at all to the faradic current, and become more sensitive to the voltaic. There may also be notable fibrillar twitchings in the muscles undergoing this atrophic process.

Sensibility is unaffected. Skin and tendon reflexes are abolished. The temperature of the affected limbs is lowered; and the feet especially are apt to be cold and cyanotic.

Soon the arms become affected in a similar manner, and here the paralysis may first affect either the extensors or the flexors. It may remain more or less limited to certain groups of muscles, or may gradually extend so as to implicate the whole limb. The distal parts are usually, however, more completely involved than the proximal. In the arms the same kind of phenomena occur as in the lower extremities, and there is a similar absence of rigidities or contractures.

There is no tendency to the formation of bedsores, and the nutrition of the skin seems to be unimpaired.

The rectum, the bladder, and the sexual organs are usually quite unaffected.

After a time, the excessive reaction of the wasted muscles to the galvanic current decidedly diminishes; though in the earlier stages of this affection the electrical 'reaction of degeneration' exists with all its characteristic details.

Prognosis, Course, and Terminations.—In the subacute cases, after a month or two, improvement may gradually begin to manifest itself; and in exceptional instances this may go on slowly, but steadily, to complete recovery. In

other of these cases, however, certain muscles or groups of muscles do not undergo the same improvement as the others; they may continue paralysed, and become more and more atrophied.

In the more chronic cases, recovery is scarcely to be looked for; though after the symptoms have developed to a certain extent, it occasionally happens that no further advance is made. Such patients may remain in much the same condition for years.

In another class of cases the malady proves more continuously progressive, so that after implicating the upper and lower extremities severely, the morbid process may extend to the upper cervical region of the cord, so as greatly to interfere with respiration; or it may even extend to the medulla, so as to involve the tongue and pharyngeal muscles, and more or less interfere with the functions of articulation and deglutition. In such cases death is liable to occur through asphyxia or slowly progressing exhaustion.

In the majority of cases of this disease, more or less complete recovery occurs, though it may be only after two to four years.

Diagnosis.—This malady bears a closer resemblance to the 'acute spinal paralysis' of adults than to any other affection. The two diseases are naturally distinct in their modes of initiation, but as established diseases (that is, in their later phases) they would be very difficult to discriminate from one another in the absence of definite information as to modes of onset—and such information is often not to be obtained. It is the abrupt commencement of the paralysis over a wide area of the body that is met with in, and which is so distinctive of, 'acute spinal paralysis'; whilst in the subacute forms, and more especially in 'chronic atrophic spinal paralysis,' we have to do with a distinctly progressive spread of the disease from part to part.

In regard to the discrimination of these subacute and chronic forms of spinal paralysis from some other varieties of spinal cord disease, the reader may refer to what has been said concerning the grounds on which the diagnosis of 'acute spinal paralysis' is to be made (*see* (11), **Acute Spinal Paralysis of Adults**).

In 'amyotrophic lateral sclerosis' the upper extremities may be paralysed, wasted, and flaccid as they are in 'chronic spinal paralysis'; but then in the former disease there would be the characteristically different combination of paralysis without wasting, but with more or less rigidity in the lower extremities.

For the distinguishing characters of 'acute ascending paralysis' see the account of that affection, in the preceding article.

Treatment. — Possibly counter-irritation to the spine in the early stages may do good, and should certainly be tried. Local bleeding would probably be useless. A nutritious and easily digestible diet, tonics, and rest are essential in the early stages, together with a thorough supervision of the general health. Later on, electrical treatment by the voltaic current must be had recourse to, and must be perseveringly continued for long periods, until the muscles again begin to respond to the faradic current. The electrical treatment is what is principally to be relied upon, and except in the subacute cases it may be commenced almost from the first, should the patient happen to come under observation during the early stage of the malady. Sulphur or brine-baths seem at times to do much good.

14. **Progressive Muscular Atrophy.** *See* Progressive Muscular Atrophy.

15. **Pseudo-hypertrophic Paralysis.** *See* Pseudo-hypertrophic Muscular Paralysis.

16. **Locomotor Ataxy.** *See* Locomotor Ataxy.

17. **Spasmodic Spinal Paralysis.**—Synon.: *Paralysis spinalis spastica*; Primary Sclerosis of the Lateral Columns; Idiopathic or Primary Lateral Sclerosis; Fr. *Tabes dorsal spasmodique* (Charcot); Ger. *Spastische Spinalparalysie; Primäre Sklerose der Seitenstränge des Rückenmarks; Primäre Lateralsklerose des Rückenmarks.*

This is one of the most recently-recognised of the diseases of the spinal cord. It was described first by Erb in 1875, and within a few months of the same time in a thorough and independent manner by Charcot. Although these observers indicated with precision the probable pathology of the disease, they were not able to verify their anticipations by the examination of any patient who had died from (or whilst suffering from) this complaint. This last step has been recently accomplished in this country by Dr. Dreschfeld.

But even before the disease was distinctly described, its probable existence and principal features were in part anticipated by Türck and by Charcot—both of them being guided more especially by the clinical effects produced by 'secondary degenerations' in the lateral columns, as occurring in association with hemiplegia.

Ætiology and Pathology.—The disease is distinctly more common in males than in females; it occurs in the majority of cases in adults from twenty to fifty years of age. Erb and others have also described spasmodic forms of paralysis occurring in children, which may possibly be instances of this disease. The writer has met with it once in a child of about ten years of age, but then the lateral sclerosis seemed only to form a prominent part of what was really a 'multiple sclerosis' of cerebro-spinal type.

In some cases the disease appears independently of any appreciable predisposing or exciting causes; but, in other instances, falls or other traumatic influences seem to be distinctly connected with its origin. On rare occasions exposure to wet and cold has seemed to have had some influence over the genesis of this, as well as over so many other forms of spinal disease.

Anatomical Characters.— In the only undoubted case which has yet been investigated *post mortem*, namely, in that of Dr. Morgan, where the spinal cord was examined by Dr. Dreschfeld (*British Medical Journal*, January 29, 1881, p. 152), the following pathological conditions were observed:—'The cord, when examined in the fresh state, showed to the naked eye no abnormality, except softening in the lowest dorsal region. After hardening in bichromate of

ammonia, sections of the cord showed already to the naked eye one light-coloured patch in each lateral column'—and this throughout the cervical, the dorsal, and the lumbar regions of the cord. This band of morbid tissue, presenting all the typical characters of a sclerosis, occupied the greater portion of the lateral columns, but without implicating the grey matter or extending quite to the surface of the cord. The anterior and the posterior columns were perfectly healthy. The microscopical characters of primary sclerosis in the spinal cord are briefly described in the article on 'multiple sclerosis.' *See* (19) **Multiple Sclerosis of the Spinal Cord.**

The occurrence of the slight softening in this case was an accidental complication, otherwise the lesions actually found agreed very perfectly with Charcot's scientific predictions as to the probable pathological changes peculiar to this affection of the spinal cord.

Symptoms.—This disease often sets in almost imperceptibly, and the symptoms continue to develop themselves in a very slow and gradual manner.

Patients begin to complain first of mere weakness of the lower extremities, and this continues to increase till a well-marked condition of paresis exists. There is great difficulty in getting upstairs, and the feet begin to drag even when the patient walks on level ground. This paresis may soon be associated with more or less of muscular twitchings, often more marked in the morning, but sometimes more especially at night, and of a painful character. Soon an actual stiffness of the muscles of the legs begins to manifest itself, which becomes apparent principally when passive movements are attempted, or even when the patient seeks himself to move the limbs. At last some amount of rigidity of muscles may be more or less continuously present, so as greatly to interfere with locomotion, or in some cases even to prevent it altogether.

In the early stages of the disease, ankle-clonus can be elicited with the greatest ease, and the knee-jerk is found to be distinctly exaggerated on both sides. When one of these patients is in the sitting posture, commencing pressure on the toes of one foot, as in the act of rising, will at once initiate the characteristic tremors of ankle-clonus. All such signs, however, will probably diminish as the rigidity becomes more marked.

Whilst the patient is able to walk he often exhibits a typical 'spastic gait.' The legs are generally kept close together, owing to a spasmodic contraction of the adductors of the thighs; the toes trail or are dragged along the ground; and then, when the heel is beginning to be brought down, a spasmodic contraction of the calf muscles may take place, tending to raise the patient upon his toes and almost throw him forward. In this way a mixed and very irregular kind of walking is necessitated, partly to be accounted for by mere powerlessness, and partly by the occurrence of strong muscular spasms. In some instances, either owing to variations in the amount of the spasms, or it may be to the great weight of the patient, this spastic walk is not well-marked. In all cases, however, it is quite different from the ataxic gait; and when standing with feet close together, no increase of unsteadiness or feeling of vertigo is occasioned when the patient closes his eyes.

Sensibility is little, if at all, affected; still, in some instances it is apt to be slightly impaired. In one case, at present under the writer's care, ability to recognise differences of temperature was for a time greatly lessened; and although tactile sensibility is scarcely at all interfered with, the patient has frequently complained of a diminished power in appreciating the exact positions of his legs. Skin-reflexes are often normal, but occasionally they may be slightly increased.

The muscles do not atrophy, and their electrical reactions continue to be almost normal; whilst, according to Erb, that of the nerves is slightly but distinctly lowered to both currents. Sexual desires are not affected, but sexual disability may be occasioned to a variable extent—partly owing to weakness or actual paralysis, and partly to mere spasms of muscles. Micturition is often scarcely at all interfered with; there is nothing like incontinence of urine or of fæces, though there may be an obstinate amount of constipation.

No vaso-motor or trophic disturbances in the limbs are usually present.

As the disease progresses (it may be very slowly, and in the course of years) the muscles of the trunk become affected, so that weakness and spasms (often of a very painful character) occur in the abdominal and back muscles. After a time the arms also may become implicated, and in the same fashion as the legs, excepting that when permanent contractions of the muscles come on, they mostly fix the arm to the side, whilst the forearm is pronated and half-flexed, and the fingers and wrist are strongly flexed.

In rare cases the disease is limited to one side of the body, beginning, for instance, first in one leg, and then extending to the arm on the same side, so as to present a kind of hemiplegic distribution. Just as rarely, too, the disease may first affect the two upper extremities, and then extend down the trunk, so as ultimately to involve the lower extremities.

During the development of the disease shivering fits, affecting the muscles of the jaws as well as almost all the muscles of the body, may occur from time to time, lasting for half an hour or more, and though quite unaccompanied by any changes of temperature, they may, nevertheless, be provoked by cold. Sometimes, however, such attacks occur spontaneously; or they may spread from some accidentally initiated ankle-clonus, or other well-marked spasm.

Persons suffering from this disease often remain in an almost stationary condition for a series of years, at any particular stage of the disease that may happen to have been attained. Ultimately, however, there is a tendency to complete paralysis of the parts affected, with permanent contractures—the legs at this stage being often immovably fixed in a condition of rigid extension. As a rule, pains are not complained of at any stage of the disease, though some patients suffer much from painful cramplike contractions, occurring either in the lower extremities, or else in some of the abdominal muscles.

Complications.—So long as the morbid process

remains limited to the lateral columns, no other symptoms present themselves. Should it, however, invade the grey matter in particular regions of the cord, then characteristic complications are apt to arise, and it may also be said that the gravity of the disease becomes very distinctly increased. The way for a fatal termination may then be paved through the gradual increase, for instance, of bladder-troubles; or through the occurrence of severe bed-sores, and collateral events to which they may give rise.

Another possible extension of the sclerosis is to the posterior columns, so that we may get a variable mixture of the symptoms pertaining to 'spasmodic spinal paralysis,' and to 'locomotor ataxy.' It should be borne in mind, however, that such a complicated clinical grouping sometimes develops in the reverse order.

Usually in patients suffering from this disease, there is no association with cerebral symptoms, nor is there any tendency to the springing up of cerebral complications. Still, in one case under the writer's care a subacute maniacal condition became developed; whilst in another case diabetes to a slight but tractable extent has manifested itself. In both instances, however, there happens to have been a marked hereditary predisposition to the occurrence of insanity and of diabetes respectively.

Prognosis.—As hinted above under the head of complications, so long as the disease-process remains limited to the lateral columns, as it does in the great majority of cases, 'spasmodic spinal paralysis' carries with it no danger to life. Such patients may survive for an indefinite time, even though for years after permanent contractures have become established they may have been absolutely confined to bed. Still Erb speaks of two cures, and of decided improvement in some other cases, and is inclined to think that this affection may prove a little more amenable to treatment than some of its congeners.

Diagnosis.—The grouping of symptoms met with in this disease is so characteristic, that there ought to be no difficulty in recognising it. In no other affection of the spinal cord have we the combination of a gradually progressive paralysis beginning in the lower extremities, associated with muscular twitchings and rigidities; greatly exalted tendon-reflexes; no impairment of sensibility and no pains; no wasting of muscles or other trophic changes; and no interference with the functions of the bladder and rectum.

The real difficulty arises in the recognition of the complex forms of the disease, or of combinations of this disease with others, then coming under observation for the first time. This, for instance, is the case where we have to do with a combination of posterior and lateral sclerosis, in which, in order to arrive at a diagnosis of the existing condition, the observer must be able to recognise the respective effects or modifications that may result from the combination of the two diseases. Another difficulty of the same kind arises when the symptoms of the disease are complicated by extension of the sclerosis to the grey anterior horns, the characters of which will be next described under the head of *Amyotrophic lateral sclerosis.*

Again, when 'multiple sclerosis' affects in the main the lateral columns, the real diagnosis can only be arrived at by the recognition of symptoms which could not be produced by a mere affection of the lateral columns. Thus the writer has at present under his care a little girl, ten years of age, first brought to him on account of head-symptoms, which suggested the possibility of intracranial tumour, but in whom, after a few months, signs of lateral sclerosis have become developed in a very typical manner. She now presents the most characteristic spastic gait, being frequently raised quite upon the points of her toes as she walks. There is also great exaggeration of the tendon-reflexes, and no impairment of sensibility. The case seems clearly one of 'multiple' or 'cerebro-spinal sclerosis.'

Treatment.—In the treatment of 'spasmodic spinal paralysis,' as in that of locomotor ataxy, we must use such means as are most likely to be of avail in checking the causal process of sclerosis in the columns of the cord. The general health of the patient, and the regulation of his mode of life, must receive our most careful attention. Sound sleep must also be ensured, as far as possible.

Nitrate of silver has been praised by some; but the writer believes that, on the whole, more good is to be obtained from iodide of potassium in eight- or ten-grain doses, either with or without liquor arsenicalis. Small doses of cod-liver oil also seem to do good. There is no particular indication for electrical treatment in this disease: but stimulation of the skin and subjacent parts, by frequent frictions and shampooings, may be of service, and so also may sulphur baths. There are mostly no pains to be allayed; but occasionally painful cramp-like contractions of the muscles cause much distress to patients suffering from this disease. These pains are difficult to relieve, though good may be done, in some cases, by the extract of calabar bean in increasing doses. For the rest, any accidental accompaniments of the malady must be treated upon the general principles applicable to the management of other spinal affections. 'Nerve-stretching' might be beneficial, as in certain cases of locomotor ataxy, though there is room for doubt on this point.

**18. Amyotrophic Lateral Sclerosis.**—Synon.: Fr. *Sclérose latérale amyotrophique.*

This is an extremely interesting and rare affection, which might perhaps be regarded as a mere variety of the ordinary lateral sclerosis; still it is a variety which pursues a very distinctive course, and constitutes a disease much more formidable than its prototype, since it seems almost invariably to lead to a fatal termination in two or three years.

Pathology, and Anatomical Characters.—The peculiarity of this form of lateral sclerosis lies principally in the fact that it commences in the cervical region, and soon spreads to the contiguous anterior horns of grey matter; thence, after more or less of an interval, it extends in two directions:—(*a*) downwards, so as to involve the dorsal and lumbar lateral columns, and also the contiguous anterior cornua of grey matter; and (*b*) upwards, so as to im-

plicate the upper cervical region of the cord and the medulla oblongata in a similar fashion.

Thus it will be seen that there are three peculiarities about this form of lateral sclerosis; (1) that it begins in the cervical region of the cord, and subsequently affects the lumbar portion; (2) that it does not remain limited to the lateral columns, but soon spreads to the contiguous anterior cornua, where it leads to destruction of the great motor ganglion-cells; and (3) that it almost invariably extends upwards also, so as to involve the medulla oblongata, and thus to gradually bring about the death of the patient.

Symptoms, Course, and Terminations.—Being marked by the anatomical characters above described, it will be easily understood that patients suffering from this disease present an admixture of such signs and symptoms as may be met with separately in 'lateral sclerosis,' in 'progressive muscular atrophy,' and in 'bulbar paralysis.' We have, in fact, the following typical grouping and sequence of symptoms:—

1. Paresis, gradually increasing to actual paralysis of the upper extremities, and soon associated with distinct muscular atrophy, fibrillar twitchings, &c. Any movements that can be executed are weak, and associated with tremors. More or less marked rigidity of muscles, and finally actual contractures occur, in which the arms are fixed close to the sides of the body; the forearms are semi-flexed and pronated, whilst the hands and fingers are strongly flexed.

2. After an interval of some months, a similar group of symptoms becomes developed in the lower extremities. Again, we have paresis gradually increasing, with muscular tensions, exaggerated tendon-reflexes, and an increasing amount of rigidity of the lower limbs, which are usually fixed in the extended position. At a later period in the lower extremities, as compared with the arms, a process of muscular atrophy sets in, with development of the 'reaction of degeneration,' and fibrillar twitchings in the affected muscles.

During the whole of this time, there is little or no interference with sensibility. There is usually no implication of the sphincters, and no tendency to the formation of bed-sores.

3. In the last stage of the disease, there is evidence of extension of the morbid process upwards to the upper cervical region and the medulla. Signs of bulbar paralysis present themselves in the usual way, by paralysis with atrophy of the tongue and lips, and by progressive weakening of the muscles of the palate, pharynx, and larynx. The phrenic nerve has also generally become involved, and when weakness of the diaphragm is added to weakness or actual paralysis of the other muscles of respiration, this all-important function becomes more and more impaired, and thus a fatal termination may at any time be easily brought about. Increasing difficulty of articulation and deglutition may have existed for some months before death.

Prognosis.—As already indicated, the prognosis is bad; the disease usually advances to a fatal termination in from one to three years.

Diagnosis.—In the early stages, when amyotrophic lateral sclerosis affects the arms only, it is characterised by its gradual, painless onset, the absence of impairment of sensibility, the fact that weakness sets in first, and that twitchings and tensions of muscles soon declare themselves, either before or after the muscular atrophy becomes very obvious. This combination is already sufficiently distinctive, in the absence of pain in the back, tenderness over the spine, or any other evidence of vertebral disease.

When the disease advances to its second and third stages, the picture becomes gradually more and more distinctive, and easily to be separated from all other affections of the spinal cord: especially if we are duly impressed by the negative symptoms, namely, the absence of sensory impairment, of bladder-troubles, and of bed-sores.

Treatment.—Little success has hitherto attended the treatment of this disease. The indications are to endeavour to arrest the process of sclerosis, partly by the most assiduous attention to the general health, and partly by the administration of iodide of potassium, either alone or in combination with arsenic or small doses of bichloride of mercury. In the early stages faradisation should be had recourse to; sulphur or mineral baths may be tried; and, if possible, residence in some high and bracing health-resort, or at all events in a climate where much time may be spent in the open air. In later stages little can be done, except by general treatment.

### 19. Multiple Sclerosis of the Spinal Cord.

Synon.: Disseminated Sclerosis; Insular Sclerosis; Multilocular Sclerosis; Fr. *Sclérose en plaques disséminées*; Ger. *Multiple Sklerose des Rückenmarks.*

Nature and Ætiology.—Nothing approaching to an adequate recognition of the characters and importance of this disease was made anterior to the year 1866. Then, and in the two or three subsequent years, the malady may be said to have been identified and characterised by Vulpian and Charcot, but more especially by the latter and his pupils.

It is a disease produced by the development of patches of sclerosis (overgrowths of neuroglia) of varying size and shape, throughout the spinal cord, and also in different parts of the brain. Clinically the disease is met with under the most diverse forms, according to the different sites and sizes of the patches of sclerosis occurring in different cases. These different forms of the disease are divisible into three partially distinct types, according as the morbid changes and symptoms occur in and are referable (1) to the spinal cord alone (*spinal type*); (2) to the cerebrum alone (*cerebral type*); or (3) to the brain and spinal cord (*cerebro-spinal type*). As the dominant symptoms of the disease are often those of the spinal type, even where there is also an extension of the morbid process to the cerebrum, it will be most convenient to speak here in the main of the 'cerebro-spinal' type. It is, moreover, both more frequent and a more characteristic malady than either of the simpler forms.

In regard to the ætiology of the disease, little can be said. It may occur with or without the

predisposing influence of a neurotic tendency. It is at least as common in females as it is in males; and though rarely occurring in children under ten years of age, it is perhaps most common between the ages of ten and thirty years. Beyond the age of forty it again becomes excessively rare.

Amongst the exciting causes, exposure to wet and cold would seem to take the first rank. After this come traumatic influences of various kinds, mental shocks or troubles, great fatigues from mental or bodily labour, and finally the state of convalescence from several acute diseases, such as typhus, cholera, variola, or other specific fevers. It has, indeed, been said to occur sometimes as a sequence to severe and long-continued hysteria; but in some of such cases at least it would seem to be far more probable that the early and obscure symptoms connected with this affection were those which were regarded as hysterical. 'Hysteria' may be produced or simulated in many ways, but as itself a producer of organic changes its *rôle* is assuredly open to grave doubts.

Anatomical Characters.—The patches of sclerosis which constitute the anatomical basis of this disease, do not differ in their essential nature or in their appearance (macroscopic or microscopic) from the similar overgrowths of the neuroglia that occur in locomotor ataxy and in primary lateral sclerosis.

On the cut surface of the spinal cord, medulla, or other portion of brain, the foci of sclerosis mostly reveal themselves as greyish, greyish-red, or semi-gelatinous yellowish patches, differing principally by reason of slight contrasts in colour, from the dead white of the more healthy columns of the cord, and from the natural appearance of the grey matter. The tissue of the patches may either be level with, project slightly above, or sink slightly beneath, the general cut surface of the cord. The same differences also exist in regard to those patches which involve the external surface of the cord—they may at times, when the new growth is excessive, rise slightly above the surface; whilst later on, when shrinking has occurred in the cirrhotic patch, some amount of superficial depression may be met with.

The patches vary much in size; in the spinal cord they range from a mere pin's head to that of a large pea, or of a bean; whilst in the cerebrum or in the cerebellum they may attain still larger dimensions. In the spinal cord the patches occur in all parts of its longitudinal extent, and they may occupy very variable portions of the transverse area of the cord. Some involve principally the lateral, others the anterior or the posterior columns of the cord; or portions of the grey matter, either alone or in conjunction with one or more of these columns, may be implicated for a variable extent, transversely and longitudinally. Patches of different sizes, and varying in their transverse extent, occupy different levels of the cord, and may thus occur in an irregular series throughout the organ.

These spinal foci of sclerosis, again, may be associated with patches of the same kind distributed through the medulla, pons, and cerebral peduncles, in part superficially and in part within their substance. Similar patches may be found in variable number, and quite irregularly distributed, through other parts of the cerebrum, as well as through the cerebellum.

In regard to the *microscopical characters* of these foci of sclerosis, certain differences are met with in different cases, principally dependent upon the age, or stage of formation, of the patches. Without going into minute details, it may be said that there is in all cases a hyperplasic overgrowth of the neuroglia which naturally exists around and between the nerve-elements. The nature of this change becomes quite distinct when properly prepared sections of the cord have been tinted. The new tissue takes the staining fluid freely, and when the circumference of a patch (especially some small one) is examined, it becomes obvious that numerous thickened processes of neuroglia connect it with the healthy tissue around. It is by the hypertrophy and gradual fusion of these circumferential prolongations that the morbid growth progressively encroaches upon the previously healthy portions of the cord. As this mere intermediate tissue grows, it presses upon and constricts the nerve-fibres and nerve-cells, so as to cause atrophy of the latter and a partial atrophy of the former. For there is reason to believe that the nerve-fibres do not wholly disappear; in these patches of primary sclerosis (as in the case of 'secondary degenerations') it is the white substance of Schwann which disappears, whilst the axis-cylinders, or a considerable number of them, persist. In the new tissue itself we find the usual granular or very finely fibrillar matrix, containing minute spherical or ovoidal plastides, also branched cells, and occasionally a few granulation-corpuscles. The latter are met with especially during the earlier stages of a patch of sclerosis; just as corpora amylacea or colloid bodies may be found in older patches. The walls of the capillaries as well as of arteries and veins are generally greatly thickened, and the vessels in a patch of this kind may be both numerous and large; in other cases, however, the number of vessels existing in the patch is by no means so conspicuous. It is well known that the adventitia or outer coat of the vessels in these patches is specially apt to become thickened, and that this sort of over-growth may extend inwards, so as to cause fibroid degeneration of the middle coat and even of the intima. It is probable that proliferation also takes place from the inner surface of the intima (an endarteritis), and that occasionally, owing to this cause, a thrombosis may be brought about. Certain it is that the writer has on several occasions found the larger vessels of a patch of spinal sclerosis blocked by an old and firm thrombus.

Pathogenesis.—With reference to the starting point of a patch of sclerosis something may be attributable to general causes or tendencies, such as exist in scrofulosis, in syphilis, or in other cachectic states of the system. Still, a general tendency of this kind to hyperplasia can only be adduced as a very partial explanation, since not unfrequently disseminated sclerosis may be met with in the absence of any cachexia; and, moreover, patches of sclerosis may occur in the nervous

system only, or to no notable extent in other organs of the body. This, therefore, would indicate the existence of something, or of some process, of an abnormal kind taking place in the spinal cord and brain, and again not uniformly through them, but in foci situated here and there. It is no explanation, as some seem content to suppose, merely to say that the abnormal processes are 'chronic inflammations'; since whether it is or is not advisable to speak of the changes by this name, we should still have to ask what is the cause of such local departures from healthy nutrition. Does the process begin in the connective-tissue elements themselves? or is there some primary change in the small vessels (possibly of the nature of endarteritis) leading to obstructions and a sequential overgrowth of the neuroglia? It would seem pretty certain, at all events, that the change in the nerve-elements proper follows the overgrowth of the neuroglia—as certain, indeed, as that throughout a band of 'secondary degeneration' the order of these changes is exactly reversed. There fatty degeneration and atrophy of the nerve-fibres are the first events, and these are followed by hyperplasia of the neuroglia. *See* Introduction, § 6, (13).

One of the most interesting facts, in connection with these patches of primary sclerosis, is to be found in the circumstance that they themselves rarely lead to bands of descending 'secondary degeneration' in the anterior or lateral columns, or of ascending degeneration in the posterior columns. The fact itself has been long observed, and always regarded as rather surprising. The writer believes it to be explicable by the fact previously mentioned, that the bulk of the axis-fibres remain, so that the nerve-fibres below the seat of lesion (or above in the case of the posterior columns) are not absolutely cut off from the nerve-cells which exercise a 'trophic' influence over them. Some nerve-tremors may still pass along the damaged fibres in the sclerotic patch,[1] and thus the nerves in the parts beyond do not degenerate as they would do if the fibres had been absolutely cut across. Some fibres may be completely strangled and then absorbed, and in such a case the continuations of these nerve-fibres would degenerate. In the final stages of a sclerotic patch this kind of sequence is apt to occur; so that towards the end there may be the tendency to the occurrence of some amount of secondary degeneration, even though the degenerated fibres may not constitute a very compact band.

Symptoms.—It can easily be understood, from what has already been said, how much the symptomatology of this disease is liable to vary in different cases, according to the varying situation, extent, and order of evolution of the morbid patches. That it is possible to assign anything like a definite symptomatology for this affection, is due to the fact that there are certain seats of election in which the patches of sclerosis are specially apt to occur. The sites affected with special frequency are the lateral columns of the cord, the medulla, and the pons; and it is with the occurrence of patches of sclerosis in these situations that we have the following set of correlated symptoms pertaining to the 'cerebro-spinal' type of the disease.

A slowly ensuing paresis of the lower extremities begins, first in one limb and then after a time it involves the other. During this time the paresis develops into a more and more marked paralysis, though the sensibility of the limbs remains almost completely unaffected—nothing more than a temporary numbness being complained of in the majority of cases, whilst lightning-like pains and girdle-sensations are altogether absent. After an interval, first one and then another upper extremity may become weak and subsequently more or less paralysed. During these early stages of the disease more or less distinct remissions of symptoms may occur from time to time.

Meanwhile a most typical sign soon shows itself in the paretic or semi-paralysed limbs, in the form of a marked trembling or shaking of those muscles or parts of a limb which are called into voluntary action with any intensity, although these phenomena immediately subside when the voluntary exertion ceases. The involuntary movements consist either of extremely well-marked tremors, like those met with in some cases of paralysis agitans, or else of movements of greater range, more resembling those of chorea.

Later some paresis of the trunk-muscles may occur, as well as of those of the neck; and this may be followed by a similar affection of the tongue, lips, and facial muscles—possibly, also, of those of the palate, pharynx, and larynx. When a patient affected in this manner, who has been previously lying perfectly still in bed, is told to endeavour to sit up, shakings and tremors begin in almost all parts of the body, and the scene is strangely changed until all voluntary efforts cease and the recumbent position is again assumed. The same kind of thing is seen when movements of particular parts of the body are attempted: thus when, in the sitting posture, the patient attempts to hold up one leg, tremors of it immediately begin; ask him to take hold of something or to squeeze a dynamometer, and the upper extremity called into action at once begins to shake; request him to put out his tongue, and immediately irregular protrusions of the organ occur, associated with twitchings about the angles of the mouth and even in other parts of the body. The act of walking may cause, in more or less advanced cases, tremors of the legs, arms, trunk, head, and neck—all at the same time.

Movements of slight intensity occasion either no shakings or merely tremors of a very fine kind. The latter are seen in the early stages of the disease, when writing is attempted. Almost each letter registers a number of fine tremors, mixed here and there with greater irregularities. In more advanced cases, however, the movements are so disorderly that writing becomes either impossible or wholly illegible.

Just as there is no loss of ordinary sensibility, so we find that patients remain fully conscious as to the positions and movements of their limbs, and that closure of the eyes occasions no increased uncertainty of their movements; nor,

[1] In support of this, there is the fact mentioned by Charcot, that an optic nerve which was affected through its whole thickness by sclerosis was yet capable of performing its functions.

when in the standing position, are they rendered more giddy or more unsteady by such a proceeding.

Up to this stage there may be no distinct interference with the functions of the bladder or the rectum. The tendon-reflexes are, however, generally distinctly exaggerated; ankle-clonus may be obtained with readiness, and the knee-jerk is often more pronounced than usual. There is no tendency to the formation of bed-sores; no wasting of muscles; nor is any alteration in their electrical excitability met with.

After variable and often long periods, the affected lower extremities, which have become more and more paralysed, may in some cases show signs of commencing bar-like rigidity. The limbs, as the patient lies in bed, are closely drawn together, and in a condition of rigid extension, which is generally increased when any attempts to move them are made. At first this condition of the limbs ensues from time to time, in the form of paroxysms lasting for an hour or two. But, after a time, the attacks are both more frequent and longer, so that ultimately the condition of rigidity becomes permanent. Contractions of the arms are less common, and when they occur they become fixed at times in a different position from that met with in simple lateral sclerosis (*see* **Spasmodic Spinal Paralysis**); that is, like the lower extremities, in a condition of extension, and closely drawn to the sides of the body. At this period ankle-clonus can often be elicited with the greatest ease, and the movements of the one leg may extend to the opposite lower extremity, and may indeed set up more or less of general tremor throughout the body. Exposure to cold, or irritation of the skin in various ways, will also often suffice to set up this general tremor, which, as Brown-Séquard showed, may commonly be caused to cease instantly by a forcible flexion of one of the great toes. With the cessation of the tremors consequent upon this manœuvre, the limbs may also be left for a time in a supple and flaccid condition.

The manifestation of tremors of the tongue, lips, and face is of course a sign that the medulla oblongata is affected; and when this occurs, simultaneously, or very soon after, other evidences of the implication of the medulla and of contiguous portions of the cerebrum may be met with. Articulation may become more or less affected, the speech being rendered slow, hesitating, and measured, syllable by syllable; or it may be jerky in character—becoming especially thick and blurred in the later stages of the disease. The power of swallowing is less frequently impaired, but in advanced stages it is apt to be affected.

Nystagmus is very frequently met with. Diplopia, or actual paralysis of the ocular muscles, is rare. Amblyopia not unfrequently exists; perhaps, in one eye only. Actual blindness is very rare.

Vertigo, sometimes to a marked extent, is no uncommon symptom; and as the cerebrum becomes more and more affected, a condition of well-marked hebetude, or actual dementia, gradually becomes pronounced. This betrays itself externally by a blank, expressionless aspect of the face; the patient becomes childish in manner, his memory fails, he takes interest only in trifles, laughs constantly also at the merest trifles, or, on the other hand, is very easily moved to tears.

During this condition of things a subacute maniacal condition may supervene; or the patient may develop 'delusions of grandeur' precisely similar to those met with in 'general paralysis of the insane'—examples of which the writer has recently seen in two of his own patients. In other cases persons suffering from this disease may lapse into a profoundly melancholic condition.

At this stage, too, apoplectiform or epileptic form attacks are particularly apt to occur from time to time. After such attacks, of whichever kind, the limbs on one side of the body and the face are left more or less paralysed; and where the attack has been epileptiform in character, the convulsive twitchings are often limited to this one side of the body. As Charcot has pointed out, these attacks are precisely similar to those which occur in general paralytics, or in cases of old hemiplegia with descending sclerosis. They answer to the so-called 'congestive attacks,' but, as Charcot contends, they do not seem to be associated with any new appreciable lesions of a 'gross' order. Such epileptiform attacks may be brief, or they may last for hours; or, off and on, even for days. In all of them the temperature begins to rise almost at once—without any initial period of depression—and may even reach 104° in a few hours, or in a day or two. The temperature then begins to fall again; or should it continue to rise to a still higher point, the attack is very apt to terminate fatally.

Every attack of this kind leaves the patient in a manifestly worse condition, both bodily and mentally; and perhaps in one of them at last death may occur.

Varieties.—The symptomatology of this disease is likely to be considerably modified in different cases, but principally in two directions, productive of complications of the same kind as those which are also apt to occur in 'spasmodic spinal paralysis.' In each disease there may in some cases be a special affection of the posterior columns, in one or other region of the cord, bringing with it more interference with sensibility, and an admixture of other symptoms pertaining to locomotor ataxy. It is, perhaps, principally in these cases that the '*crises gastriques*' (pains, vomiting, and occasionally diarrhœa) are also met with. In other instances there may be an extension of the sclerosis to the grey matter of the anterior cornua in one or other region (as well as to other parts of the grey matter), leading, amongst other phenomena, to muscular atrophy in related regions of the body. In either of these ways the symptoms of the original disease may be complicated, and, to a certain extent, obscured.

Many other differences also present themselves in special cases, owing to the varying situations in which the morbid patches make their first appearance. In a fair proportion of the cases the disease seems to reveal itself first in the brain rather than in the spinal cord.

Terminations.—After pursuing a very slow course for years (often five to ten), the miserable sufferers from this disease may at last be carried off in various ways. Death may take place in one of the apoplectiform or epileptiform attacks,

occurring either in patients who are merely slightly demented, or in those who are otherwise actually insane; or, at last, in cases in which there is great interference not only with articulation but also with deglutition, the functions of the heart or of respiration may also become affected, and may thus lead on to a fatal termination.

In other cases, after the disease has lasted for years, and when the grey matter of the cord has become seriously involved, accidents may supervene similar to those which occur in the final stages of many cases of paraplegia. The bladder may become paralysed, and after a time inflammation and ulceration may be set up, followed by secondary inflammation of the ureters or kidneys. Or bed-sores may form, sloughing may go on extensively, and the patient may at last die exhausted, or from the supervention of blood-poisoning or some acute inflammatory disease.

Diagnosis.—In its early stages the diagnosis of this disease may present very considerable difficulties. This is especially the case when the morbid process begins in the cerebrum. Here for a time there may be nothing distinctive, and we have to wait for the further development of the disease before anything like a positive diagnosis is possible. Similarly, where the disease begins only with spinal symptoms, it is often extremely difficult to diagnose it with certainty in its very early stages. The important characters in the more typical forms of the disease are the youth of the patient, the paresis gradually increasing, first in one and then in the other lower extremity, with no alteration in sensibility or in the electrical irritability of the nerves or muscles. When ankle-clonus becomes easily obtainable, and when, moreover, the peculiar tremors and disordered movements on voluntary excitation of the muscles are met with, together with the absence of any such tremors in the condition of rest, and some amount of paresis or of similar symptoms in one or both upper extremities, the diagnosis of the 'spinal' type of this disease can be no longer difficult or doubtful.

By far the most typical cases, however, are those of the 'cerebro-spinal' type, in which, with such symptoms as are above indicated, there are also some others due to disease of the medulla or pons—such as have been indicated in speaking of the symptomatology of the disease. In these cases the disease is really quite distinctive; so that even when the patient is seen at this stage for the first time, the malady ought to be easily recognised. Chorea is the affection with which it is most apt to be confounded; but the absolute cessation of all tremors and disordered movements in multiple sclerosis when the patient is at rest, and their immediate re-initiation (mainly in the parts moved, but also often to some extent in others) on the occurrence of voluntary efforts, is a thoroughly distinctive characteristic.

Paralysis agitans ought to be distinguished from disseminated sclerosis with even more ease. It is scarcely ever met with in persons under the age of thirty-five, just as multiple sclerosis is only rarely met with in persons beyond such an age. The movements of paralysis agitans are only to a slight extent exaggerated by voluntary exertion of the parts; and such movements, in the form of fine tremors, do not cease to anything like the same extent under conditions of rest. There is generally no shaking of the head and neck in paralysis agitans.

Mercurial poisoning with tremors can be easily distinguished, on inquiry into the history of the patient, and the mode of onset of the disease.

In those more irregular cases of multiple sclerosis, in which there is either an implication of the posterior columns of the cord, or of the grey matter in some region or regions, the diagnosis of the complex nature of the affection must be based upon the general principles applicable to the regional diagnosis of spinal cord disease.

Prognosis.—Absolute cure of this disease is scarcely to be hoped for. The most that has been done, hitherto, as a result of treatment, has been to bring about more or less distinct remissions, and also to delay the progress of the disease. Death usually occurs in from five to ten years, in one or other of the modes already indicated.

Treatment.—Many drugs have been tried, but hitherto with little or no positive result, in the treatment of this affection. Nitrate of silver has seemed to do good in some cases, especially in the early stages. But the writer is much more disposed to trust to iodide of potassium in eight- or ten-grain doses three times a day, with or without moderate doses of perchloride of mercury or of liquor arsenicalis; combining the use of those drugs with cod-liver oil and a good nourishing diet. From time to time, however, the above medicines should be omitted, and simple tonics taken in their place. In the early stages of the disease, sulphur baths and shampooing of the limbs may be of service; and in all cases it is of great importance to see that the patient obtains sound sleep, since in this, as in all other chronic spinal diseases, the patient's downward course is sure to be greatly hastened where refreshing sleep is not obtained.

No distinct indications exist for the treatment of this affection by electricity, and no advantages have as yet been recorded from its use. The complications of the disease, which may occur in its later phrases, must be treated in accordance with the general principles applicable for this as for other spinal affections. Every effort must be made to preserve the general health of the patient, as this will probably be found to be the surest means of arresting or holding in check the progress of the disease.

**20. Spinal Cord, Tumours of.**—Synon.: Intra-medullary Tumours; Fr. *Tumeurs de la Moelle; Tumeurs rachidiennes*; Ger. *Krankhaften Geschwülste des Rückenmarks.*

Ætiology and Anatomical Characters.—Tumours originating in the substance of the spinal cord may be regarded as belonging to two classes, according as they represent (*a*) mere *local* accidents in the form of perverted tissue-changes; or (*b*) such local accidents developing under the influence of a distinct *general state*, such as syphilis or scrofulosis.

(*a*) Of the purely *local* overgrowths, the most typical, and perhaps also the most fre-

quently occurring are *gliomata*. The consideration of these growths comes in natural sequence to that of *sclerosis* affecting different regions of the cord. In such a tumour we have an exuberant overgrowth, as Virchow and most other pathologists suppose, starting from the neuroglia of a certain portion of the cord. At first the growth infiltrates and substitutes itself in the place of a certain amount of nerve-tissue; but it soon grows excessive in quantity (spreading in area perhaps at the same time), and thus comes to exercise a more and more marked compression upon the remaining tracts of nerve-tissue composing the cord at the same level, within the narrow and unyielding boundaries of the spinal canal. These gliomata are oftentimes extremely vascular. They are liable to undergo a certain amount of central softening; and into their substance, especially in the softened foci, hæmorrhages are very apt to occur. Softening of nerve-tissue may also, at a certain stage, take place around the growth, and thence may extend for a variable distance above and below.

Other tumours of an allied nature, such as *sarcomata* and *myxomata*, also at times develop, either in their pure types or with blended characters, within the spinal cord. They present few intrinsic peculiarities in their manner of affecting the cord. They rarely attain any large size; indeed the limitations of the spinal canal only permit of much increase in one direction. And elongated growths are occasionally met with. To a considerable extent, such tumours have an infiltrating mode of growth, though their boundaries are apt to be rather more defined than are those of gliomata.

In regard to the causes of these tumours, almost nothing more definite can be said than that they seem, at times, to find occasion and conditions suitable for their initiation after some blow upon the spine or concussion of the spinal cord.

(*b*) Of the growths which tend to occur in the spinal cord (as occasionally in other parts of the body) under the influence of some *general* disease or diathetic condition, two are especially to be named. These are *scrofulous growths* ('tubercular'), and *syphilitic gummata*. The former are generally small, varying in size from a mustard seed to a pea, and only very rarely attaining the dimensions of a hazel-nut. Next to gliomata they are the new growths most frequently met with in the substance of the spinal cord. When small, they may occur in association with a cerebro-spinal tubercular meningitis; but at other times they are found, and especially the larger growths, existing independently of any acute inflammation of the meninges. In this latter case, the tumours may be combined with a certain amount of adjacent and secondary softening of the substance of the cord.

Syphilitic gummata, originating in the cord itself, occur only with the greatest rarity. They are more frequently found starting from the meninges, and then they may press upon or actually grow into the nerve-substance.

*Cancer* is believed not to occur primarily in the substance of the spinal cord, though it may grow into its substance, or seriously press upon it, when originating either in the meninges or in the vertebræ.

Symptoms, Course, and Terminations.—The difficulties of diagnosis are almost always very great in the case of tumours of the spinal cord, because in their early stages, and occasionally for prolonged periods, they are associated with slight and somewhat vague symptoms.

Independently of the variations in different cases, consequent upon the longitudinal situation or level of the tumour in the spinal cord, the symptoms to which they give rise in various parts of the body may be more or less vague anomalies of sensibility in different regions, associated with a certain amount of weakness, often not amounting to actual paralysis.

Growths from the meninges, or from the vertebræ, pressing upon the spinal cord, are not quite so apt to run a latent course for any length of time, since they are rather more prone to involve the anterior or the posterior roots on one or on both sides—at first irritating them, and subsequently causing paralysis from pressure. Thus localised numbness, pains, or anæsthesia, either alone or associated with twitchings, cramps, or paralysis, confined to certain parts of the body, are rather more common incidents during the growth of extra- than of intra-medullary tumours. Still the diagnosis between these two classes of tumours may be impossible.

Sclerosis, in its 'insular' form, especially when the patches are few or close together, may also present symptoms almost inseparable from the first stage of some intra-medullary tumour. The important fact is, however, that sclerosis in the cord tends to become more and more generalised, and thus gives rise to a proportionately widening range of symptoms; or else it limits itself to special columns, and thus becomes associated with more special sets of symptoms.

With any of these tumours of the spinal cord, the symptoms are, after a time, liable to undergo a sudden and grave increase, owing to the occurrence of a hæmorrhage into its substance and perhaps into adjacent regions of the spinal cord, or else owing to the commencement of a process of secondary transverse softening. Beyond these possibilities of sudden grave augmentation of symptoms, the course of intra-medullary tumours is also apt to be marked by peculiar exacerbations and remissions from time to time, in association with periods of altered growth or vascularity of the tumour itself.

Diagnosis.—The very gradual onset of the symptoms in cases of tumour of the spinal cord, is a point of great importance in the diagnosis of these conditions. Thus, for instance, we eliminate arachnoid or intra-medullary hæmorrhages, and also the numerous class of cases of softening of the spinal cord, with other affections having a more or less abrupt origin. The diagnosis of tumour of the cord as distinct from its compression by disease of vertebræ (where there is also generally a slow evolution of paralytic symptoms), must be based in part upon the absence of any evidence of vertebral disease. The diagnosis from meningeal tumours has already been referred to under the head of symptoms; and so also has the diagnosis from

mere sclerosis of the spinal cord, in which the connective-tissue overgrowth is not sufficiently bulky to amount to an actual tumour.

If the arrival at a diagnosis as to the existence of a tumour of the spinal cord is a process beset with difficulties, these by no means cease when, passing from the primary, we have to approach the secondary question as to the *nature* of the growth presumed to exist. But little is possible in this direction. It is true that, with a history of pre-existing syphilis, even without the evidence of other simultaneous manifestations, we should be warranted in assuming it to be even more than possible that an existing growth was syphilitic in nature, and in treating the patient accordingly; and that all the more because this is about the only kind of new-growth as to which we have distinct evidence of its amenability to the influence of remedies. The presumptions in favour of the tubercular or scrofulous nature of a supposed new-growth in the spinal cord, would rarely carry with them more than a moderate amount of cogency. Still, occasionally the general habit of the patient, together with the fact of the existence of scrofulous enlargement of glands, or of some forms of phthisis, might give more or less probability to such a conclusion. Beyond this not much can be done in the way of diagnosing special kinds of tumours. We might be guided in our opinion as to the possible existence of a sarcoma by the presence of one or more of such growths in other parts of the body; or failing this, we may recollect that primary cancer affecting the spinal cord is almost unknown, and that gliomatous tumours are, next to the tubercular or scrofulous, those which are most frequently met with in the cord itself.

Prognosis.—The prognosis in all these cases is bad. Life, it is true, may last for months or even years, but the tendency is for the primary affection to set up other secondary accidents, in the form either of hæmorrhage or of softening. Thus, paralysis is rendered more complete, and the way is paved for an ultimate fatal termination, through the intervention of cystitis and renal mischief; by way of bed-sores with exhaustion and blood-poisoning; or by extension of softening upwards to the cervical region and the supervention of respiratory paralysis.

Treatment.—In the case of the existence of a syphilitic tumour in the spinal cord, we may attempt (and with some expectation of success) to treat the causal morbid condition with large doses of iodide of potassium, either alone or in combination with bichloride of mercury. But in almost all other cases little can be done in this direction, and we are reduced to the necessity of dealing with the paraplegic state, and its attendant conditions, as best we can, and also of attending to the general health, with the view of arresting the progress of the disease, and keeping its possible complications in check. *See* section on Treatment, in **Spinal Cord, Softening of.**

**21. Spinal Cord, Malformations of.**—Various conditions are comprised under this head which are of little or no interest to the practitioner. The spinal cord may be absent, imperfectly developed, or double. Again, cases occur in which the spinal cord is either unduly long or unduly short, or in which it may present some trifling lack of symmetry. One of the most interesting of these latter conditions is due to the fact recently discovered by Flechsig of the possible non-uniform distribution of the pyramidal tracts upon the two sides of the cord, so that the amount of decussation of the motor fibres, not only in different individuals but also in the two halves of the same cord, may be quite unequal. In the latter case an asymmetrical development of the antero-lateral columns on the two sides would be met with.

*Congenital dilatation of the central canal of the Spinal Cord* (*Hydrorrachis interna*, or *Hydromyelus*), though an interesting pathological condition, does not reveal itself by any distinct symptoms during life.

Confusion is, however, apt to arise between this mere unimportant congenital anomaly, and the existence of cavities in various parts of the grey matter of the cord, more or less centrally situated, which are to be regarded as remainders or products of some pre-existing pathological changes. These latter conditions have received much attention, and the various forms have been described under the name, originally given by Ollivier, of '*Syringomyelia*.' Here, again, we have to do with matters of exclusively pathological interest.

Congenital dilatation of the central canal in its most developed form is apt to be connected with *spina bifida*. *See* Spina Bifida.

**II. Diseases of the Spinal Cord dependent upon Unknown, or very imperfectly-known, Organic Changes.**

**22. Tetanus.** *See* Tetanus.

**23. Tetany.** *See* Tetany.

**24. Torticollis.** *See* Wry-Neck.

**25. Writer's Cramp, &c.** *See* Writer's Cramp.

**26. Spinal Irritation.** *See* Spinal Irritation.

**27. Reflex Paraplegia.** Synon.: Urinary Paraplegia (in part); Fr. *Paraplégie reflexe*; *Paraplégie fonctionnelle*; Ger. *Reflex Paralysis spinalis.*

General Remarks.—Some practitioners believe that paralyses of various kinds are brought about purely by reflex influences. They would include under this category some of the cases of paralysis of separate muscles, such as the ocular; some cases of paralysis of one or both arms; or some of the cases of paralysis of one or both lower extremities. It is the latter class of cases with which we are now specially concerned, though much of what is to be said in the present article may, *mutatis mutandis*, be considered applicable to the whole class of so-called 'reflex paralyses.'

Those who believe in the frequent existence of this form of paralysis are considerably less numerous than they were twenty years ago, when the notion of its frequency and importance was warmly espoused by Brown-Séquard (*Lects. on Paral. of Lower Extremities*, 1861), and when

the morbid anatomy of the spinal cord was still very imperfectly known. The number of competent observers was smaller, whilst the difficulty in detecting morbid changes in this organ was much greater then than it is now that we are accustomed to employ more elaborate methods for its preservation and for its examination. Yet one of the strongest of the arguments brought forward in favour of the existence of 'reflex paraplegia' was the absence of discovered lesions in the spinal cord in a class of cases reported upon by Stanley in 1833 (*Med.-Chir. Trans.*, vol. xviii. p. 260) in which paraplegia was associated with various morbid conditions of the urinary organs—cases, in fact, of the so-called 'urinary paraplegia.' And the main support for the opinions of those who still believe in the existence of a class of reflex paraplegias, now also lies in the absence, in certain cases of paraplegia terminating fatally, of any actually-discovered lesion.

Ætiology and Pathogenesis.—The interpretation of the paralyses of this class put forward by Brown-Séquard is as follows:—That an irritation, operating upon certain sensory nerves, produces impressions which, after impinging upon the properly related grey matter in the spinal cord, are thence in part reflected along vaso-motor nerves regulating the calibre of certain blood-vessels which supply either (*a*) the portion of the spinal cord in relation with the paralysed parts, or else (*b*) the great nerves or the muscles themselves of the paralysed parts. In either case this reflection of impressions resulting from irritation of sensory nerves, upon such special groups of vaso-motor nerves, is supposed to lead to a persistent spasm of the vessels which they innervate, so as to cause a continuous anæmic condition, either of certain vascular territories in the spinal cord itself, or else of the related nerve-trunks and muscles. In either case, too, the nutrition of the parts involved in this anæmia is supposed to suffer—so that their functions can no longer be carried on or only in a very imperfect manner—and thus a more or less complete paralysis results, which is capable, however, of being mitigated from time to time, of actually intermitting, or indeed of being abruptly cured, according as temporary diminutions or a complete disappearance of the original exciting cause may lead to a diminution or to an actual cessation of the supposed profound anæmia produced by the supposed spasms of vessels. These are the theories upon which the doctrines of 'reflex paraplegia' are based.

Among the sources from which the initial irritation is supposed to proceed, almost all parts of the body, internal as well as external, are included. Thus irritative impressions, it is thought, may emanate from almost any part of the urinary tract—from the urethra to the kidney; in other cases similar impressions may emanate from some portion of the female genital organs; in others from the intestinal canal, owing to the presence of worms or some such persistent causes of irritation; in others from some portion of the thoracic organs; or, as it seems to be held, from irritated sensitive nerves in almost any part of the body, whether situated near the surface or deep amongst the tissues.

The assemblage of symptoms supposed to characterise these forms of reflex paralysis presents nothing like a distinctive mode of grouping. And of the several components of the group put forward by Brown-Séquard in 1861 (*loc. cit.*, p. 33), as pertaining to one of the most typical varieties, viz., 'urinary paraplegia,' none can now have any pretensions to be regarded as distinctive, excepting the alleged tendency of the paralysis to vary in degree with variations in the malady on which it is supposed to depend, together with its tendency to spontaneous or easy cure coincidentally with or soon after the cessation of the urinary troubles, whatever they may have been. In harmony with this latter character also are the alleged facts that speedy cures have been brought about of cases of paraplegia, especially in children, after the expulsion from the alimentary canal of tape-worms or round-worms; or, of cures of the same disease in adult females after the cessation of some uterine inflammation; or of cures of a paralysis of ocular muscles after the removal of some carious tooth which had previously been exercising an irritative influence upon branches of the dental nerve.

It would be improper and useless to deny the existence of such cases; they are theoretically possible. On the other hand, the writer is compelled to believe, after a very extensive experience, that, if they exist, they can only occur as extremely rare events.

Although it is theoretically possible that an irritation of a sensory nerve may be reflected on vaso-motor nerves, so as to lead to arterial spasms in certain territories of the spinal cord or in certain groups of muscles, neither proof nor even analogy exists in favour of the view that such a condition of spasm could be maintained for days or even weeks. Nor, if it could occur for these prolonged periods, and to such an extent as to annul some of the most important functions of the spinal cord during this time, is it at all clear that the nutrition of the cord in the affected regions would not be seriously interfered with by such prolonged anæmia; and if so the assumed speedy resumption of healthy functions after the disappearance of the vascular spasms would constitute another difficulty, since such speedy recovery would be incompatible with the theory upon which the explanation of the disease is based.

Again, it is almost certain that many of the cases formerly supposed to belong to this category of 'reflex paralysis' had no right to figure therein. Cases of diphtheritic paralysis have been proved to belong to a different category; and there is good reason to believe that in other instances the morbid conditions really existing as causes of the paralysis have simply been overlooked, either because the appreciable changes were only slightly advanced at the time of the patient's death, owing to the brief duration of the illness, or because of the want of a thorough examination of the cord, conducted with all needful aids, care, and expenditure of time.

It seems clear, therefore, that the opinions of those who believe in the existence of 'reflex paralysis,' and of 'reflex paraplegia in particular, stand much in need of further support. Well-observed and well-recorded instances of the disease are urgently wanted, if reflex paraplegia is to retain its claim to a place in our nosology.

28. **Intermittent Paraplegia.**—Synon.: *Intermittent Spinal Paralysis*; Fr. *Paralysie Spinal Intermittente*; Ger. *Intermittizender Paralysis Spinalis.*—Very few cases of paraplegia of this type have been recorded, and it must also be a condition of extreme rarity.

The earliest recorded example was made known by Romberg, and as this, both in its nature and its course, seems to have been a typical instance, it may be cited here. 'A woman, sixty-four years of age, after being quite well the day before, was suddenly attacked with paralysis of the lower extremities and of the sphincters. Sensibility was unchanged, consciousness clear, the temperature cool, pulse 80, small and empty, no pain in the spinal cord. The next day there was an astonishing change in the condition. The patient could walk again and void urine voluntarily, and only complained of weakness in the legs. The following morning there was paraplegia again, which had set in at the same hour as it had done two days before. A third paroxysm was awaited, which also set in at the appointed time, although without paralysis of the sphincters. Quinine effected a rapid cure.'

Two other cases are cited by Erb. In one of them there were also three attacks before cure took place under the influence of quinine; but in the other, observed by Hartwig, attacks of intermittent paralysis seem to have gone on for many months It is worthy of note that in the two former cases there is no statement that the patient had previously suffered from ague; whilst in that of Hartwig, although the man had been afflicted with tertian intermittent fever five years previously, for a few weeks, there is no mention made of the recurrence of any other symptoms of this type, even during the period that the patient continued subject to the attacks of intermittent paraplegia.

We know absolutely nothing as to the real cause or intimate pathology of such attacks. Any future cases, therefore, deserve to be observed and recorded with the greatest care. Meanwhile it should be remembered that the cases already observed seem to have proved extremely amenable to the influence of quinine and of arsenic.

29. **Hysterical Paraplegia.** *See* Hysteria.

30. **Paraplegia dependent on Idea.**—Nature and Ætiology.—This is a form of paralysis, of purely 'functional' type, ccasionally occurring in neurotic impressionable persons, and yet not dependent upon any ordinary hysterical condition. Attention was first called to such cases by Dr. Russell Reynolds, who cited, amongst others, a typical instance in which a young lady, whilst attending to a paraplegic father, amidst the additional anxieties consequent upon straitened circumstances and the fatigues incident to teaching in order to obtain the bare necessaries of life, became at last, under the influence of long-continued strain, together with an abiding fear (inspired by actual physical weakness) that she herself was becoming paralysed, reduced *de facto* to this condition, as the final outcome of a slowly-increasing weakness (see *British Medical Journal*, November 6, 1869).

Pathology.—Such a condition may occur quite independently of hysteria, and be just as free from anything like conscious simulation or desire to exaggerate. We cannot say positively that the state is induced by what is called 'inhibition,' or by definite vascular spasms such as are supposed to form one of the pathological bases of the class of so-called 'reflex' paralyses, and yet both these modifying influences over the functional activity of the spinal cord *may* be in part operative when imagination, continuously excited in some one direction, has a tendency to pervert the functional activity of this portion of the nervous system.

The same conditions that exist as more lasting states in these cases, probably exist temporarily, under the influence of suggestion, in hypnotised persons. *See* Magnetism, Animal.

Symptoms.—There is a paralysis of motion in the lower extremities, more or less complete, often partial, and generally without implication of sensibility. There is unabated control over the bladder and rectum.

Dr. Reynolds points out that, while such patients may be wholly incapable of lifting a foot from the bed, they often find themselves able to turn or sit up without any assistance. And in slighter cases, though they may be unable to stand for a moment, such patients may yet be able to move the legs in any direction while in the recumbent position.

Diagnosis.—The character of the paralysis, and its limitation in range, is thought to be of importance. But still more important is the establishment of the fact of the pre-existence of long-continued fears or fancies (in a person of delicate or neurotic temperament), of such a nature as to be in accordance with the patient's now-present condition, combined with the absence of all signs positively indicative of any structural defect in the spinal cord.

Where such a condition exists (as it may) as a mere complication of an actually existing structural disease, the diagnosis becomes either impossible or extremely difficult. It is, in fact, only possible after prolonged observation and experience as to the course of the symptoms.

Prognosis.—The prognosis is extremely good if the nature of the malady be divined, and a right course of treatment adopted. Under such circumstances, an almost complete cure may easily be brought about in a week or ten days; but, failing this recognition, the morbid condition, may, it is said, under ordinary treatment, persist for an almost unlimited period.

Treatment.—The practitioner must inspire the patient with confidence that the malady is curable, and surround her (or him) with cheerful, hope-inspiring attendants and influences. At the same time, with the view of supporting her confidence (if for no other reason), he should faradise the muscles of the apparently paralysed limbs daily, or have recourse to frictions or shampooings combined with passive movements. He must make the patient attempt to stand or walk, with the necessary support; administer opiates, or bromide of potassium with chloral, to procure sleep, if necessary; and carefully seek to restore the patient's general health and nutrition. In this class of cases especially, it would

seem probable that the influence of 'suggestion,' if hypnotism could be induced according to Braid's method, might be capable of producing an almost immediate cure. *See* BRAIDISM.

**31. Neurasthenia Spinalis.**—SYNON.: Functional Nervous Weakness of the Spinal Cord.

NATURE AND ÆTIOLOGY.—Under this name, descriptions have been given of a combination of symptoms not unfrequently met with in males as well as females, but more especially in the former. They are supposed to represent a condition of extreme nervous debility, coming on obscurely, or at all events not as a sequence of some previous severe illness or shock. Still the symptoms met with often approximate closely to those pertaining to a state of convalescence from some serious febrile illness; and are not at all unlike some of those which may follow concussion of the spinal cord.

Such symptoms when occurring independently are most prone to show themselves in those who are naturally of a neurotic temperament. They may be excited by over-fatigue of various kinds, especially when this has been coupled with disturbed sleep for some time. Prolonged exercise or over mental work may have been the particular exciting causes of fatigue; though perhaps much more frequently this is to be found in sexual excesses (of a natural or unnatural order), either extending in the form of habitual indulgence over a considerable period, or as more isolated but marked excesses. At other times, symptoms of neurasthenia spinalis set in without obvious provocatives of either type.

PATHOLOGY.—Concerning the actual cause of spinal neurasthenia little or nothing can be said. Sometimes there may be the co-existence of distinct cerebral symptoms of an analogous type; though on other occasions the symptoms are more purely spinal. This malady is perhaps capable of being induced by mere altered molecular states and actions of the tissue-elements of the spinal cord. A kind of persistent 'fatigue condition' exists, so that their nutrition cannot be properly maintained. Although some may imagine the existence of some more than usually anæmic condition of the spinal cord, of this, as a fact, there is no evidence. To speculate upon other modes in which such a set of symptoms might be brought about, would in the present state of our knowledge be of little service. There is, however, the possibility that this morbid condition may be due in the main to a functional disease of the cerebellum—especially if the views of Rolando, Luys, and others, as to the functions of this great organ, should prove correct even in part.

SYMPTOMS.—A feeling of utter weakness and prostration induced by even the smallest amount of muscular exertion, is the central symptom, though this is usually associated with coldness, and more or less numbness of the extremities. Pains, too, may be felt in the muscles of the limbs and in some parts of the back, though there is commonly no tenderness over any part of the spine. These symptoms may be unusually distinct after any activity of the genital function, and they may then be associated with extreme wakefulness, or sometimes with protracted inability to sleep. Occasionally, and especially when this latter symptom is not present, the patients may present a florid and fairly healthy appearance, strangely at variance with the extreme debility complained of.

DIAGNOSIS.—The points of greatest importance are the existence of extreme weakness, with no evidence of anything like actual paralysis, or indeed of any symptoms which would indicate an actual structural disease of the spinal cord. This being so, and diabetes being also eliminated, we may oftentimes (and especially where the existence of one or other of the above-mentioned exciting causes has been established) pretty confidently conclude that we have to deal with what is here named 'neurasthenia spinalis.'

PROGNOSIS.—A relief of this condition is ultimately to be looked for under the influence of rest and suitable treatment; but in regard to the rapidity with which any such amelioration of the patient's symptoms is to be brought about, great differences exist in different cases. Weeks, months, or even years may be required before a natural amount of vigour is restored.

TREATMENT.—Rest, especially in the direction of previous excesses, is the first and indispensable requisite. Every effort should be used to obtain regular and sound sleep. The action of these potent restoratives should be supplemented by a generous and easily assimilable diet, together with a moderate amount of stimulants. Hypophosphites of the alkalies with iron and small doses of strychnia (which may be conveniently given in the form of a syrup) often prove decidedly beneficial. An abundance of fresh air is desirable, and especially that of elevated and bracing mountain situations. Daily frictions and shampooing, aided by stimulating saline baths, may also prove to be of much use.

**32. Toxic Spinal Paralysis.**—Under this name it will be right to refer to a class of cases of paraplegia produced by poisons of various kinds. It constitutes a somewhat heterogeneous group, concerning which our knowledge is still very defective—in the main, because such cases are happily of rare occurrence.

Of the toxic agents taken into the body, and capable of entailing a paraplegia, some are minerals, such as arsenic and lead; others are of vegetable origin, such as aconitia, conia, veratria, prussic acid, ergot, and alcohol; whilst others again are of animal origin. In the majority of cases, their action as 'causes' is not sufficiently potent to lead to paralysis as anything like an invariable effect. They need the concurrence of other favouring circumstances, probably in the main intrinsic; but under the combination of conditions thus resulting, a paraplegia may be induced—in actual modes, however, that may differ considerably among themselves. It is only in this attenuated sense that the above-mentioned poisons are to be regarded as 'causes' of paraplegia. They ought perhaps, from this point of view, to be considered as predisposing rather than as exciting, and in no case as proximate, causes of paraplegia.

This holds good, for all that we know, concerning the fitful and irregular manner in which

arsenic, lead, or alcohol (and probably to a similar extent other toxic substances) give rise to paraplegic symptoms in those who have taken them to excess. Thus, according to Tanquerel des Planches, out of 200 cases of lead-poisoning, in only fifteen did the paralysis implicate the lower extremities; and in only one of these did it occur as a distinct paraplegia. This case might, therefore, have been due to a fortuitous combination of conditions—in short, it might have been a coincidence rather than a definite result of the taking of lead. Again, in regard to arsenic, it is true that in certain cases Orfila observed paraplegic conditions in dogs which had taken large quantities of this drug; but such symptoms would seem to be met with only occasionally as a result of acute arsenical poisoning in man, and perhaps with equal rarity in those who habitually consume large quantities of this substance.

Probably the mode of action of alcohol as a cause of paraplegia is very nearly as general and ill-defined, yet Dr. Wilks goes so far as to speak of an 'alcoholic paraplegia,' resulting from excesses in spirit-drinking. Alcohol, like many poisons, when taken in undue quantity, may deteriorate the nutrition of the body generally; it may spoil the integrity of its more delicate tissues, and thus interfere with the discharge of some of its finer functions. In this way, through general spoiling and degeneration, the way may be led on to the development of special changes favouring paralysis, now in this and now in that part of the nervous system. If either one of a group of possible morbid changes, induced upon such a basis, chances to affect principally the lower part of the spinal cord, a paraplegia may be induced. The principal justification, however, for speaking of such a state as an 'alcoholic paraplegia,' probably lies in the fact that here (as indeed in all cases of toxic paralysis) the first therapeutic indication is to be found in the renunciation of the harmful agent.

The notion has recently been advanced by Moxon, that a certain class of poisons, which own the common property of being 'depressants of the circulation,' have a tendency to paralyse the hind legs rather than the fore legs of animals. In this group are included aconitia, conia, and—doubtfully—veratria, chloral, and prussic acid. He is of opinion that these drugs act by causing further impediments 'to the exceedingly and peculiarly difficult blood-supply of the caudal end of the spinal cord' (*British Medical Journal*, April 2, 1881, p. 498). It should be borne in mind that extreme feebleness of blood-current is of itself a common cause predisposing to the occurrence of thrombosis both in arteries and in veins, and that such a condition may intervene in some of these cases of poisoning, and lead to the development of paraplegia. This would enable us to account for the otherwise inexplicable fact of the maintenance of the paralysis long after other effects of the poison have passed away. H. Charlton Bastian.

**SPINAL IRRITATION.** — Synon.: Rachialgia; Fr. *Rachialgie*; Ger. *Rückgratschmerz*.

Definition.—Notwithstanding the doubts that have been entertained by many authorities, both British and foreign, spinal irritation is an affection which has a real existence and deserves a special name. Although spinal irritation may be, like other affections, allied with, or caused by, various organic or functional nervous diseases, the name ought to be kept for a special spinal complaint, chiefly characterised by a morbid excitability of the sensitive nerves of the spine, manifesting itself by spontaneous pains, and by tenderness under pressure, or when the affected parts are moved.

Ætiology.—Rachialgia is more common in certain countries than in others—more so, particularly, in Great Britain, Ireland, and the United States than in Continental Europe. This probably accounts for the fact that this affection was first studied and described by a number of Irish and American writers. Sex is an important ætiological element: out of 304 cases collected by the two Griffins and by Hammond, there were only forty-two men. The writer has seen it in three men only out of more than fifty cases. It occurs chiefly in girls between fifteen and twenty-five. As regards other causes the most important are:—excessive walking or driving; violent movements of the spine, or a blow upon it; abuse of sexual intercourse; masturbation; and severe diseases, such as typhoid fever, scarlatina, fever and ague, dysentery, and diphtheria.

Anatomical Characters and Pathology.—In simple rachialgia there is no organic alteration that the naked eye can see, or the microscope can show. At most a congestion is sometimes found. Still organic affections of the spine and its fibrous tissues may give rise to the functional affection we are now studying, so that a necropsy may show pathological alterations of various kinds in the fibrous and bony tissues of the spine. As regards the physiological pathology of spinal irritation, the symptoms belong to two distinct groups, one composed of local morbid manifestations, and the other of those which are distant. As regards the first of these groups, it includes tenderness and the various kinds of pain; there is, in a measure, similitude between the symptoms and those of neuralgia. The tenderness especially is often similar to that which is detected in some points of a nerve attacked with neuralgia. Still there are differences (especially as regards the kinds of pain) which prevent a complete assimilation of rachialgia with a common neuralgia. The group of symptoms appearing at a distance from the spine, is composed of reflex or direct effects of irritation of the spinal nerves. Among these symptoms we find referred sensations, muscular spasms, increased tonicity, contraction of blood-vessels, trembling, alterations of secretion and nutrition, inhibition of the heart, &c.

Dr. Quain communicates to the writer his conviction that spinal pain and tenderness exist more often as transmitted or referred phenomena connected with morbid states of the mucous membrane than is generally recognised. Thus he finds pain present over the posterior cervical region in cases of congestion or follicular disease of the mucous membrane of the pharynx and adjacent parts. In the dorsal region the like pains and tenderness are constantly found in cases of gas-

trodynia, associated, it may be, with morbid states of the mucous membrane of the stomach. In the lumbar and sacral regions similar conditions are traceable in connexion with disordered states of the mucous membrane of the intestines, or of the urinary and genital organs. As we find extreme sensitiveness of the retina in cases of disease of the conjunctiva—or as we find pain at the end of the penis in cases of stone in the bladder—so may we have many of these other reflex or referred troubles in connection with distant disorders.

Symptoms.—*Spinal tenderness.*—This is the essential and only constant feature of rachialgia. Its existence, however, might not be found out if questions were merely asked, or a cursory examination were made, as the symptom may be slight and localised in one vertebra, and the patient may not be aware of its presence. It may be found in any part of the spine, and correspond to only one, to many, or even to all of the vertebræ. When very limited, tenderness exists more frequently at the lower part of either the dorsal or the cervical regions, less often in the latter. The symptom is elicited in two ways —by pressure or movement. When the tenderness is slight, pressure will succeed in showing its existence, while a movement might prove ineffectual. It is essential to be extremely cautious in making pressure, as not only a considerable and lasting pain may result from sudden and great pressure, but very serious convulsive paralytic or psychic manifestations may be produced. The writer has seen cases in which attacks of catalepsy, of tonic, clonic, or choreic movements, of temporary (and in one case of prolonged) paralysis of the lower or upper limbs, of exophthalmos with mental disorder, &c., had been caused by heavy pressure on the cervical or dorsal vertebræ. Usually the place where pressure gives rise to the greatest pain is the spinous process. Sometimes, however, the disorder is unilateral, and then the seat of greatest tenderness is the transverse process. Very frequently myalgia co-exists with rachialgia, and then the muscular masses so attacked, on one or on the two sides of the spine, are very tender under pressure. There is often hyperæsthesia of the skin itself, and the writer found this so great in one case that any unexpected touch, or even a gentle breath of air on the skin, made the patient (a strong and courageous man) scream out. The tactile hyperæsthesia in that case was so great that the two points of the æsthesiometer, which on the spine are felt by a healthy person only when distant one from the other at least an inch and a half, were distinctly recognised when distant less than a line, that is, when almost touching each other. In a number of cases sensibility is morbidly increased in every nerve-fibre of all the tissues of one or more vertebræ and of the neighbouring parts. There is no absolute relation between the pain caused by pressure and the constant spontaneous pain existing in many cases, as there may be considerable tenderness without any, or with very little, spontaneous pain, and there may be only moderate tenderness although a constant or almost constant severe pain is complained of.

Tenderness is often discovered by movement of the spine performed voluntarily or involuntarily by the patient, or produced, for diagnosis' sake, by the physician. Generally, however, the pain thus generated is somewhat different from that due to pressure on the spinous processes, and is chiefly, if not only, an increase of the constant spontaneous pain.

Pains referred to the periphery of the body or to internal organs, are often associated with local tenderness developed by pressure. These transmitted pains, as well as the local pains caused by pressure, may last for hours—nay, for days, showing how carefully the examination for tenderness should be made. It is well, when we have to deal with hysterical or timid patients, to judge of the degree of tenderness more from the sudden and involuntary movement of the spine, when we press upon it, than from the patient's statements as regards the degree of local or referred pains felt. The amount of blushing of the face when a tender spine is pressed upon, is also a means of appreciating the degree of tenderness, especially when the affected part is in the lower third of the cervical region, or the upper third of the dorsal region.

*Spontaneous spinal pain.*—This symptom is less important than tenderness, because it is not constant, and also because it often exists in organic spinal complaints. It is increased in most cases by pressure on, or by movement of, the spine. According to Dr. Hammond's observation it is found in about one case out of three of spinal irritation. The writer believes that its frequency is much greater. It is quite variable in its character and degree. It may consist only or chiefly in a feeling of heaviness, of coldness, of heat, of pricking, or of itching. In many cases it increases, and in some it decreases, when the sitting or standing posture is assumed. Lying flat on the back usually diminishes, but sometimes increases it. Its seat is generally at the point where the spinal nerves emerge from the spine, resembling in this respect a neuralgic pain.

*Visceral functional disturbances.*—Rachialgia is often followed or accompanied by various functional disorders, more or less directly caused by it. The stomach and the heart are the parts chiefly affected; but other viscera (the liver, the kidneys, or the bowels) are also sometimes affected.

*Vaso-motor disturbances.*—These may appear anywhere, but the face exhibits them more often and more intensely than other parts. They consist chiefly in alternations of great paleness and flushing.

*Motor disturbances.*—A fixed contraction of some muscles, especially in the fore-arm, has been pointed out by Mr. Teale. Dr. C. B. Radcliffe says that this contraction does not disappear during sleep. This slight rigidity increases when an effort is made to loosen it. A great variety of other motor disturbances may appear in this affection, as will be mentioned hereafter.

The symptoms of rachialgia necessarily vary with the different regions of the spine.

1. **Cervical Region.**—Spinal irritation in very frequent in this region, although less so than in the dorsal. Of 304 cases collected by the two

Griffins, and by Dr. Hammond, the affection was confined to the cervical region 71 times, and it occupied parts or all of the cervical and dorsal regions in 82 cases. More than elsewhere, pressure on the spine, when the disorder is in the neck, will produce referred sensations. For instance, pressure on the two upper vertebræ may cause pain in the forehead; pressure on the third and fourth vertebræ a pain in the pharynx; and on the last cervical a pain behind the sternum. According to the best observers, especially Stilling and the two Griffins, the following symptoms have been noticed in cases of cervical spinal irritation: vertigo, headache, psychical disturbances, insomnia, nightmare, neuralgic pains in the head, face, neck, shoulders, chest, and upper limbs, contraction of flexor muscles in the fore-arms, clonic spasms, fibrillary movements in the shoulders and arms, disturbances in phonation and deglutition, dyspnœa, spasmodic cough, fainting, and palpitation of the heart.

2. **Dorsal Region.**—This is the region most frequently attacked, although the united statistics of the brothers Griffin and Dr. Hammond do not clearly establish this point. The stomach is the principal seat of disturbance in dorsal rachialgia. It shows its irritation by pain, pyrosis, eructations, nausea, and vomiting. Palpitation of the heart is not rare; but dyspnœa and cough are less frequent than in cervical rachialgia. So are neuralgic pains, involuntary movements, and tonic spasms.

3. **Lumbar Region.**—Rachialgia is rarely localised in the lumbar region. Dr. Hammond has seen it fifteen times, and the two Griffins thirteen times. The writer has only seen it four times out of more than fifty cases. It manifests itself or is accompanied by the following symptoms: neuralgia in the lower limbs, myalgia in the lumbar and abdominal regions, painful spasms of the vesical or anal sphincters, uterine and ovarian pains, with or without menstrual disturbances, disorders of motility, such as tonic or choreic movements in the lower limbs, pseudo-paraplegia, &c.

4. **General Rachialgia.**—It is assuredly quite rare to find every vertebra tender. The writer has seen it but twice. But it is not so rare to find cases in which almost every part of the spine is affected. The two Griffins have seen it in fifteen cases out of a hundred and forty-eight. Hyperæsthesia is then usually greater than in localised rachialgia. The pains produced even by the gentlest pressure on one spinous process usually extend to the whole vertebral column. The various symptoms pointed out as due to localised spinal irritation are present here together, and show themselves in the four limbs, the head, the neck, the trunk, and the internal organs—especially, however, in the heart and the stomach.

Diagnosis.—The symptoms of spinal irritation are so characteristic that it is only in cases of complication of this affection with another that doubts might arise. A sprain of the spine, intense congestion of the cellular tissue and of the muscles, and inflammation of the parts close to the spine, involving the fibrous tissue binding together the vertebræ, and due to some traumatic cause, will certainly give origin to the local and sympathetic symptoms of spinal irritation, together with those due to inflammation or considerable congestion. There cannot be a mistake. Two distinct morbid states, then, follow a blow or some other traumatic agency on the spine. In the same way we find hysteria co-existing with spinal irritation. Indeed, it is extremely rare to find that hysteria, beginning by any symptom, will not soon be accompanied by some degree of spinal irritation; and, on the other hand, in almost all cases of genuine spinal irritation, more or less marked hysterical symptoms will appear, so that these two affections almost always are, at least partly, blended together. The singular and rare affection described by Trousseau under the name of *tetany*, can hardly be mistaken for rachialgia, not only because the most important symptoms of spinal irritation are absent or very slight in tetany, but also because in this last affection the muscular contraction is generally accompanied by trembling, anæsthesia, and a feeling of great fatigue. Tetanus, and the organic affections of the spinal cord and its meninges may be put aside, as although there may be spinal tenderness in some of those affections, especially in meningitis, the other symptoms clearly establish their existence, and not that of mere rachialgia. The same may be said of Pott's disease, or other morbid structural alterations of the vertebræ.

Prognosis.—It is impossible to agree with those physicians who take a light view of spinal irritation. If an American practitioner has, as he states, cured 133 patients out of 156, he has been exceptionally fortunate. Although a cure can often be obtained, and sometimes very quickly, this affection, when at all powerful, will frequently resist treatment, or reappear after a temporary cure. The writer would say, however, that many patients refuse to submit to the most energetic means of treatment, and that, therefore, we cannot know what would have been their fate under better means than those used. Still, death is never caused in a direct way by this affection. Its worst feature is that it renders the patient most miserable from pains, weakness, and the various functional disorders it produces.

Treatment.—In this affection, as well as in all functional disorders, anæmia exists so frequently, and participates so certainly in the production, or at least in the persistence, of the symptoms, that the writer can easily accept the statement of some physicians, that certain remedies, such as iron, quinine, the mineral acids, alcoholic stimulants, cod-liver oil, arsenic, and nux vomica, have been used successfully against rachialgia. Indeed, some of these means—one or another, according to special circumstances—ought almost always to be used. The writer's own experience does not confirm that of Dr. Hammond as regards the beneficial effects he attributes to zinc. Internal remedies taken by the mouth are certainly less important than external ones, or medicines used by subcutaneous injection. As regards this last means there is no doubt that injections of morphia or atropia under the skin, especially when made near the focus of pain or tenderness, are of great service, not only for a time against

these symptoms, but also frequently against the affection itself. The writer employs with more benefit the following substances together than one of them alone in such cases, as well as in cases of neuralgia: sulphate of morphia, from $\frac{1}{3}$ to $\frac{1}{2}$ a grain, sulphate of strychnia, from $\frac{1}{35}$ to $\frac{1}{25}$ of a grain, and sulphate of atropia from $\frac{1}{50}$ to $\frac{1}{40}$ of a grain, beginning with the minimum dose, and reaching quickly the maximum one, if the increase can be borne. When the pain or tenderness is localised in a small part of the spine, the writer has obtained great relief from the use of an ointment of aconitia, two grains; veratria, four grains; and lard, two drachms. Every counter-irritant, including galvanism (if we can look upon it in such a way), has been used with benefit in some cases. Applications of ice and of the actual cautery will be found to be the best. Ice may be employed, finely pounded, as a kind of poultice, applied on a large surface and on the bare skin, or in frictions on the two sides of the spine, and by either process only for three to six minutes, twice a day. If there be no success by these means, the application of a very hot piece of flannel on the principal seat of pain is advisable, followed after five minutes by the application of ice according to one or other of the two above methods. When the whole spine is tender or painful, each of its three regions should be treated, one after the other. Next, if not first in importance, is the use of the actual cautery, after the following rules:—First, the instrument must be at *white* heat; secondly, it must have a very small surface; thirdly it must be applied quickly although firmly; fourthly, it must make, on each day of application, three or four cauterisations on each side of the spine, and these irritations must extend over two or three inches in length; fifthly, the operation is to be repeated every day for eight or ten days, care being taken that the instrument be passed each time on unaltered skin. The writer uses a Paquelin cautery, with which there is, on account of the above rules, neither great pain nor a sore produced. The outer layer of the skin dries up and becomes brown, but there is no blister or ulcer or purulent discharge. This is a most valuable means of treatment, especially when the pain and tenderness of the spine are intense. If all the means already mentioned have failed, or even when they have not been tried, and when the patient is attacked in a great extent of the spine, and is quite submissive and willing to do as she is told, *absolute rest* of the tender and painful parts is to be employed. In Hilton's valuable work on *Rest and Pain*, the rules are given which must be followed in such cases. The words *absolute rest* express exactly what is needed. It would be worse than useless to make a patient with spinal irritation lie down, and stay in bed for two, three, or four weeks, if he or she were allowed to turn in bed, or to move the spine at all at the affected part. If the rest of the part is really absolute and constant, a cure is almost always obtained after a few weeks. So long as the difficult treatment lasts, every attention must be paid to the nourishment, to the state of the bowels, and to the occupation of the mind of the patient. It need not be said that other means of treatment (especially subcutaneous injections against pain), are to be used during the period of rest. Fresh air must be admitted to the room as far as the season allows. The muscles of the limbs (which are to be left without voluntary movement) are to be gently galvanised several times a day, so as not only to improve their nutrition, but to act also on the general circulation of the blood. On getting out of bed, when it is ascertained that both pain and tenderness have disappeared from the spine, the patient must for a time (a week or more) be most careful to avoid moving the parts much which have been affected. The writer cannot conclude this article without referring the reader to a lecture of one of the ablest physicians of our time, Dr. S. Weir Mitchell, of Philadelphia, in which rules not essentially different from the above are given. *See* 'Rest in the Treatment of Nervous Disease,' in *A Series of American Clinical Lectures*, vol. i. No. 4, New York, 1875.

C. E. Brown-Séquard.

**SPINE, Diseases and Curvatures of.**—Synon.: Fr. *Maladies et Courbures du Rhachis*; Ger. *Krankheiten und Krümmungen des Rückgrates.*

General Remarks.—The vertebral column is a complex anatomical structure, consisting of large masses of bone, chiefly cancellous, forming the bodies of the vertebræ; large flat discs of fibro-cartilage placed between the bodies of the vertebræ; and connecting ligamentous structures. On either side of, and behind the vertebral canal, in which the spinal cord is placed, are the oblique articulating, and the spinous processes, with which are connected the large group of muscles, whereby the various movements of the spinal column are regulated, and the erect position of the body maintained.

All these structures are liable to special forms of disease, such as are met with in other parts of the body where similar structures exist. Hence a certain analogy may be traced between the most ordinary forms of disease which occur in the spinal column, and the joint-diseases of the extremities; but the absence of articular cartilage and synovial membrane between the bodies of the vertebræ, destroys much of the analogy. Nevertheless, in the ordinary form of disease of the spinal column, or 'Pott's disease,' we have as its chief characteristics, *caries* and *necrosis* of bone, with *ulceration* of the intervertebral cartilage, accompanied by *suppuration*. The ligaments are, as in other parts of the body, especially liable to the *rheumatic* form of inflammation. The muscles are especially liable to *paralytic* and *spasmodic* affections, such as occur in the muscles of the extremities, and other parts of the body. The spine is also very liable to various forms of *curvature*. Other forms of disease, such as *tubercular deposits*, *cystic* and *malignant growths*, are occasionally met with, but do not require special description in connection with the spinal column. The diseases of the spinal cord and its membranes are described in other articles. The only affections, therefore, which demand special consideration in this place are (1) Pott's Disease; and (2) Lateral Curvature.

**1. Pott's Disease of the Spine.**—Synon.:

Spinal caries; Fr. *Mal vértebral de Pott*; Ger. *Pott'sche Krankheit*.

Definition.—A destructive disease of the spinal column, depending upon ulceration of the intervertebral cartilages; generally associated with caries and necrosis of the bodies of the vertebræ; and named after the distinguished surgeon Percival Pott, who first described its pathological characters.

Anatomical Characters.—The disease may commence either in the intervertebral cartilages, or in the bodies of the vertebræ. In the majority of cases ulceration of one or more intervertebral cartilages occurs, as the result of subacute inflammation; and the adjacent surfaces of the bodies of the vertebræ become destroyed by caries and necrosis. When the disease commences in the bones, primary necrosis occurs in one or more of the bodies of the vertebræ, as it is observed to do in other situations where cancellous bone exists in large masses. In a later stage, the osseous and cartilaginous structures are all involved in the destructive process, and a chasm is formed in the anterior part of the spinal column, which subsequently becomes bent upon itself, the spinous processes projecting posteriorly so as to produce the distortion described as *angular curvature of the spine*. The angular form of the projection is most marked in the dorsal region, in consequence of the natural curve of the spinal column in a posterior direction, and also from the length of the spinous processes. In the cervical and lumbar regions an opposite condition obtains, and an obtuse posterior, rather than angular, projection occurs; and this may be absent, even in cases of extensive disease.

If the case proceed favourably towards a curative termination, the destructive processes become arrested, and a healthy reparative process is established, terminating in bony anchylosis between the bodies of the vertebræ, which have become approximated after the loss of structure. Ossification also proceeds along some of the ligamentous structures passing between the laminæ, as well as between the spinous processes. Thus the resulting angular, or posterior, projection becomes a persistent deformity—a deformity essential to the cure of the case.

Ætiology.—Pott's disease of the spine may be either of *local* or of *constitutional* origin. When *local*, it results from injury, and the violence may be either *direct* or *indirect*.

Cases traceable to *direct violence* are of more frequent occurrence in adult life, for instance, the fall of earth from the roof of a tunnel upon the back of a man, in the stooping position; the fall of a sack of wheat upon the back of a person passing under it; or a fall from a ladder. The evidence of direct injury is not so easily obtained when the disease occurs in childhood, but occasionally we see spinal curvature developed in robust and healthy children, who have never had any previous illness, and whose family history is unexceptionally good. In such cases we can hardly doubt that some slight accident, met with in boisterous play, must have been the immediate cause of the disease; and, in some instances the writer has obtained undoubted evidence to this effect. The immediate symptoms are slight and transient, but in the course of a few months conclusive evidence of the existence of disease is developed.

*Indirect violence* frequently gives rise to Pott's disease of the spine, and in all probability lays the foundation of the mischief in the greatest number of cases, although the accident, as a producing cause, cannot be traced in every instance, especially when the disease occurs in childhood, as it most frequently does. The kind of accident alluded to is a rick or twist of the spine, as, for example, when a child imitating the clown in a pantomime, turns head over heels, or when a boy is taken up by the arms, and swung round by a man on to his back in play. The latter occurred to a boy who was for several years under the writer's care; the immediate symptoms were not severe, and passed off in a short time, but disease of the spine was gradually developed, with external abscess, through which portions of necrosed bone came away; the boy ultimately recovered. A fall out of bed has frequently been known to lay the foundation of spinal disease, and in many of these accidents there is no evidence of direct injury to the spine. In young adults, a rick or twist of the spine received in wrestling, and in the rough game of foot-ball, or by a fall from a horse, has been known to precede the development of disease without any direct blow upon the spine. In all these cases, the injury done to the articulation is in all probability by laceration of the ligaments, just as in severe sprains at the knee and ankle-joint; and when such an injury occurs in a person of marked strumous constitution, the destructive inflammatory processes of ulceration and caries usually follow, as they do at other articulations, when both local and constitutional causes are combined.

When of *constitutional origin*, disease of the spine is generally developed in children in whom we have sufficient evidence of a strumous constitutional condition, frequently associated with a consumptive family history; still cases are often met with where we have no such indications, but in which the disease has been developed during a condition of induced constitutional debility, that is, after an attack of scarlet fever, measles, or whooping-cough. In this class of cases we have the absence of any history of a local injury, either direct or indirect, and the disease appears to depend essentially upon the constitutional condition of the patient.

Symptoms and Diagnosis.—**1. Early stage.** During the early stage of Pott's disease of the spine, that is, before the production of angular curvature—a stage which usually occupies a period of from six to nine months—the symptoms are often so ill-defined, that an accurate diagnosis cannot be formed. Two symptoms, namely, pain on motion, and pain on percussion over the spinous processes, have been too generally relied upon as indicating the existence of disease; but both these symptoms are frequently absent when disease exists, and are also present in an exaggerated form when there is no disease, so that their diagnostic importance is uncertain. Still, when present in conjunction with other symptoms, they are often of material diagnostic value. A certain amount of fixity

in a portion of the spinal column, that is, a want of flexibility in the stooping position, is of importance as showing a condition of reflex muscular contraction, similar to that which exists at the hip- and knee-joints, in the early stage of disease.

There are some *regional peculiarities* of importance in reference to diagnostic symptoms; and the special symptoms present, with more or less distinctness in different regions, may be grouped in two classes, namely—

(*a*) Pain occasioned by certain movements, in which particular muscles attached to the vertebræ which are the seat of disease, are called into play; and pain occasioned by percussion over one or more spinous processes.

(*b*) Attitudes assumed by the patient to avoid pain on motion.

In the *upper cervical region*, a constrained and fixed position of the head, to avoid pain on motion, always exists in the early stage of spinal disease; and the child finding a difficulty in keeping the head in the erect position, acquires the habit of supporting the chin by the hands, the elbows frequently resting on a table or chair. This attitude is of great diagnostic value. Occasionally in this region the disease is ushered in by obscure cerebral symptoms, resembling those of subacute meningitis.

In the *lower cervical and upper dorsal regions* there are no very distinctive symptoms, but in children there is not unfrequently a troublesome cough, sometimes supposed to be a mild form of whooping-cough, probably depending upon irritation of the recurrent laryngeal nerve.

In the *middle dorsal region* the absence of symptoms in the early stages of Pott's disease is most marked, probably from the comparative immobility of this portion of the spinal column, motion in any direction being very limited; and probably also from the absence of any muscular attachments to the bodies of the vertebræ. Local pain, and pain on percussion, are sometimes present. The patient moves about slowly and cautiously, and sometimes sits with the arms extended, the hands resting on a chair, to relieve the spine of the superincumbent weight and the effect of pressure at the seat of disease, as well as to assist in breathing.

In the *lower dorsal and upper lumbar regions*, the early stage of disease is characterised by pain experienced in the various movements in which the psoas muscles are brought into play, such as the stooping position, putting on stockings, lacing boots, or lifting even a light weight from the ground; the act of going up and down stairs; any attempt to rise suddenly from the horizontal to the sitting or standing position, especially in the morning after a night's rest; any attempt to twist the body round suddenly when lying down, as in the act of turning suddenly from the back to the stomach. In this region also may be mentioned as a diagnostic symptom the attitude assumed by the patient in the sitting position, as described in the cervical and upper dorsal region.

2. **Advanced stage.**—In the second stage of Pott's disease, that is when angular curvature is developed, any previous difficulties of diagnosis which may have existed are cleared away, and we know the disease has existed probably from six to nine months, and that a loss of substance in the intervertebral cartilage and bone has occurred. But exceptional cases, in which diagnosis may be doubtful, occasionally occur in two situations, namely, when a posterior projection of the spinous processes takes place, either of the seventh cervical and first dorsal vertebræ, or of the eighth or ninth dorsal vertebræ—situations in which it may be said that a spurious form of angular curvature may exist, as an exaggerated condition of the naturally prominent spinous processes existing in these situations. The projection of the spinous processes may be accompanied with such symptoms as local pain on pressure or percussion, pain extending along the shoulders and down the arms, leading to the suspicion of the existence of disease. When occurring in girls, the symptoms in these cases are generally due to hysteria; but as in some cases disease is subsequently developed, the diagnosis should be cautiously given, and any treatment based upon it cautiously followed out. The projection of the spinous processes of the seventh cervical and first dorsal vertebræ may often be traced to a natural conformation and family peculiarity, as we see in some short-necked and round-shouldered girls. This condition often occurs, in a more marked degree, in adults, and is increased by a thickening and hypertrophied condition of the cellular tissue, possibly also by fluid in a bursa; in such cases the neuralgic pains which accompany it are due to a gouty or rheumatic-gouty tendency.

Course, Duration, and Terminations.—The progress of Pott's disease of the spine is extremely variable, but as a general rule, within a period of from six to nine months from the commencement, angular curvature is produced. If the case proceed favourably, without external abscess or paralysis, the disease becomes arrested, and bony anchylosis takes place in about three years. When abscess and paralysis occur, the period of recovery is frequently prolonged to five or seven years. The subject of psoas and lumbar abscess will be found treated of elsewhere. *See* Lumbar Abscess; and Psoas Abscess.

Recovery from the incomplete form of paralysis which occurs in these cases, usually takes place in about two years. When the disease does not terminate favourably in bony anchylosis, death occurs; usually preceded by abscess, paralysis with meningitis, and inflammatory softening of the cord. In children the mortality is probably about one in twenty, and in adults about one in five cases.

Prognosis.—The prognosis in Pott's disease of the spine will be much more favourable in children than in adults, but in both it will be unfavourable in proportion to the rapidity with which the disease pursues its course, and also in proportion to the evidence of a strumous or tubercular diathesis; a large proportion of cases occurring in children and young adults having a phthisical family history.

Treatment.—The treatment of this disease must be both *constitutional* and *local*. The *constitutional* treatment is of importance, because in a large number of cases in which this disease occurs, there is evidence of a strumous or tuber-

cular diathesis, indicating the exhibition of cod-liver oil with hypophosphite of lime, iron, and other drugs of the same class.

The *local* treatment, especially, varies very much according to the age of the patient and the region in which the disease is seated, the principles being essentially recumbency, counter-irritation, and mechanical support. With regard to the local treatment *in the first stage*, that is, previous to the production of angular curvature, a stage which usually lasts from six months to a year, if the disease can be diagnosed, absolute recumbency should be insisted upon; and counter-irritation in some form or other, such as by blisters, the actual cautery, issues, or moxas, is also generally useful. Mechanical support to the spine in any form is not indicated in this stage.

In the *second stage* of the disease, that is, when angular curvature has taken place, absolute recumbency should still be insisted upon for a period of from one to two years from the probable date of the commencement of the disease. This is more especially necessary when disease occurs in the cervical or upper dorsal regions, as there is not only a greater tendency to paralysis, and danger to life in this situation, but when disease takes place in the upper dorsal region, and recumbency is not carried out, the ultimate deformity is always much greater than it need be. Absolute recumbency contributes not only to the arrest of disease, but to a diminution of the ultimate deformity.

When this disease occurs in infancy, or in young children, in any region, absolute recumbency must be insisted upon, the child living and being carried about in a spinal tray made of basket-work with a mattress inside. When disease occurs in the cervical or upper dorsal region, extension by the head may be combined with absolute recumbency, and this was first introduced by Mr. Fisher, who used a rack-and-pinion extension movement. The writer has adopted this principle with great advantage in a case of cervical caries, with partial paralysis, but he employed the weight and pulley attached to the upper extremity of the plane on which the patient was kept day and night.

As the case improves, in the course of one or two years, partial recumbency with mechanical support, that is, recumbency for about half the day, may be substituted for absolute recumbency, and this is especially applicable to cases of disease occurring in the middle and lower dorsal regions, when the disease is not extensive, and appears to be running a slow or chronic and favourable course. As to the kind of support, a piece of thick gutta-percha applied and moulded to the back, whilst the child is lying on its stomach, and retained by a bandage passed round the body, answers very well for hospital practice. A better kind of support is made of thick leather, blocked on a plaster of Paris cast of the back, with elastic in front. The plaster of Paris jacket applied during suspension, introduced into this country by Professor Lewis Sayre of New York in 1877, is very useful, especially in hospital practice, where any rules laid down are certain to be disregarded. The principle of applying a form of support to the spine during the progress of disease, whilst the patient is suspended by the head, is novel, and has been very useful, but must be employed with caution. It secures immobility, relieves undue pressure, and diminishes the consecutive or compensating curves, in many cases to a greater extent than can be accomplished by horizontal extension; and plaster of Paris is a very useful material for the purpose, easily obtained, and can be applied by any surgeon. The disadvantage, however, of not being able to remove it for washing purposes is very great, and the liability to the production of sores from pressure and friction, is also an objection to its use. The material which has now to a great extent superseded the plaster of Paris is the poroplastic felt, which is applied, when softened by steam, whilst the patient is suspended, and being buckled on in front, can be removed as often as required.

Partial recumbency with mechanical support, in some modified form, must be continued in all cases occurring in childhood, long after disease has ceased; and in some cases, in which the resulting deformity threatens to be considerable, even until the completion of growth.

2. **Lateral Curvature of the Spine.**—Definition.—A deformity or contortion of the spine, in which the bodies of the vertebræ deviate laterally in a horizontal direction, with or without a corresponding deviation of the apices of the spinous processes.

Ætiology.—The causes of lateral curvature are both local and constitutional, and as one or other of these causes may predominate, so the cases admit of being arranged in three classes.

*Class* 1.—Cases in which the constitutional largely predominate over the local causes.

*Class* 2.—Cases depending upon constitutional and local causes in about equal degrees.

*Class* 3.—Cases essentially depending upon local causes acting mechanically, so as to disturb the equilibrium of the spinal column.

In cases belonging to the *first class* the spinal curvature generally occurs under twelve years of age. Occasionally it is met with as a congenital affection. Many cases occur in infancy or early childhood, that is, under three or four years of age; but the majority between seven and ten years of age. When congenital, spinal curvature is sometimes associated with osseous malformation, but it also occurs without any such complication. The cases included in the first class can frequently be traced to an hereditary predisposition, lateral curvature occurring in two or three generations, and several members of the same family are frequently affected. The children usually exhibit signs of constitutional debility, and the local causes of curvature cannot be traced, except in infancy, when the children are nursed always on one arm.

In the *second class* the spinal curvature generally occurs between the ages of twelve and sixteen. Hereditary tendency is not usually traceable. These cases may be arranged in two subdivisions, (*a*) *cases depending upon induced constitutional or general debility, combined with local causes acting mechanically*; and (*b*), *those clearly of a ricketty character.*

(*a*) The local causes are the long continuance of certain bad positions, such as standing on

one leg; the long continuance of the sitting and stooping position; sitting cross-legged; occupations which render the long continuance of some particular position necessary, such as needle-work, book-folding, ironing, nursing children, and carrying heavy weights.

(*b*) The second series includes cases of lateral curvature of a rachitic character, associated with the general rachitic conformation of the skeleton.

In the *third* class spinal curvature generally occurs previous to the completion of growth. These cases are essentially unconnected with any constitutional affection or hereditary predisposition, and frequently co-exist with the natural amount of muscular strength. As local causes, in addition to habits and occupations above referred to, may be mentioned the effects of a wooden leg, and inequality in the length of the legs from any cause, such as would disturb the equilibrium of the spinal column.

Anatomical Characters. —In the so-called lateral curvature of the spine, the spinal column does not yield in a purely lateral direction, as a flexible column would bend, but presents the appearance of a spiral twist, owing to the bodies of the vertebræ turning round in a direction of *horizontal rotation*, so that their anterior surfaces are directed laterally along the convexity of the curvature. In a severe case this rotation commonly extends to a quarter of a circle in the centre of the curve, and diminishes from this point to the two extremities, so that the vertebræ, unequally turned upon themselves, cease to correspond in their natural relations to each other. This deviation of the bodies of the vertebræ does not necessarily correspond to, nor is it always indicated by, any lateral deviation of the apices of the spinous processes, although such deviation generally exists to some extent. In all cases, however, the internal deviation of the bodies of the vertebræ is much greater than the deviation externally of the apices of the spinous processes.

In all cases of confirmed lateral curvature, whether slight or severe, structural changes exist, varying in degree according to the severity and duration of the curvature. The structures affected are the intervertebral fibro-cartilages, the bodies of the vertebræ, and the oblique articulating processes. All these suffer simply from mechanical pressure, arising from the unequal distribution of the weight of the body. The fibro-cartilages and the bodies of the vertebræ suffer from unequal compression in the concavity of the curve, and become more or less wedge-shaped. The articular facets on the oblique articulating processes, which form the only direct articular connections between the separate bones of the vertebral column, undergo important structural changes at an early period of the formation of lateral curvature, that is, as soon as it becomes confirmed. These articular facets become altered in their direction and aspects, according to the extent of the lateral deviation, or rotation, of the bodies of the vertebræ. In the lumbar region, where the articular facets are naturally nearly vertical in direction, looking inwards and outwards respectively, they gradually assume, in a severe case of lateral curvature, an oblique direction, looking obliquely upwards and downwards. Mr. Alexander Shaw first directed attention to these changes in the oblique articulating processes which, as he observes, receive the weight of the body in the act of leaning to one side, and are the only bony structures which check the lateral movements of the trunk; and when any such position is long persisted in, the articulating processes, which are soft and imperfectly formed at the age of puberty, become wasted by absorption, as the result of unequal pressure. The joints of the articulating processes being situated posteriorly as well as laterally, the spinal column cannot yield in their direction, without wheeling partially round. Hence the rotation of the bodies of the vertebræ becomes confirmed, together with the other structural deviations described.

The ligamentous structures, including chiefly the short ligamentous bands passing between and connecting the bodies of the vertebræ and the intervertebral cartilages, and also the short articular ligaments connected with the oblique articulating processes, become adapted to the alterations in the bones, and in the articulating surfaces. It is an error to assume that in confirmed curvature the ligaments are relaxed, and elongated on one side, and contracted on the other, as generally described; although in the physiological condition described as 'weak spine,' with an inclination to lateral curvature, a condition of muscular debility and general ligamentous relaxation undoubtedly exists.

The muscles have not been shown to exhibit any structural changes in the early stage of lateral curvature of the spine, except in those rare instances in which the curvature depends upon partial paralysis. In the late stages, or in adult cases of long standing, the spinal muscles have been found much wasted, pale in colour, and in more or less advanced stages of fatty degeneration. In the early stages of curvature an increased prominence of the spinal muscles is observed on the convexity of the curve, whether in the dorsal or the lumbar region; but this does not depend upon any spasmodic or active muscular contraction. The muscles are simply displaced, or pushed outwards, by the angles of the ribs in the dorsal region, and the transverse processes of the vertebræ in the lumbar region, which are thus displaced as a part of the rotation movement described.

Other structural changes exist in the ribs, which become distorted and altered in shape, so as to lead to deformity of the chest, characterised by a prominence and flattening of the ribs, which become bent at their angles on the side of the convexity—usually on the right side, and a depression of the ribs on the side of the concavity.

Anteriorly, the symmetrical form of the chest is completely destroyed; the sternum becomes very oblique, its lower extremity projecting; and the cartilages of the ribs corresponding to the side of the concavity of the curve—usually the left—are prominent, and bent upon themselves. The oblique diameter of the chest, therefore, is increased, but its capacity is altogether diminished, causing considerable disturbance in the relative position of the heart and lungs, and giving rise to functional derangement of these organs.

The pelvis also becomes distorted in lateral

curvature, but only in one class of cases, namely, those of rachitic origin, in which the evidence of general rickets is unmistakably present. In all other cases of lateral curvature of the spine, the pelvis is of its full natural size, and well-formed.

Symptoms and Diagnosis.—Lateral curvature of the spine is generally supposed to be indicated by a lateral deviation of the apices of the spinous processes, but such deviation may exist either as a functional or as a structural condition. It may be seen in a case of weak spine with muscular debility and ligamentous relaxation, such as is frequently met with in quickly growing girls; or it may co-exist with rotation of the bodies of the vertebræ in confirmed lateral curvature. The evidence of rotation of the bodies of the vertebræ precedes the lateral deviation of the apices of the spinous processes in many cases, whilst in others the two conditions co-exist, and appear to take place simultaneously; but rotation of the bodies of the vertebræ may proceed to a considerable extent, the bodies moving horizontally through a quarter of a circle, with only very slight deviation laterally of the apices of the spinous processes. It is therefore the evidence of rotation we must look for in cases of commencing structural curvature, and not the lateral deviation of the apices of the spinous processes. Rotation of the bodies of the vertebræ is always evidenced by a posterior projection of the angles of the ribs on one side, and depression on the other, in the dorsal region; and a corresponding posterior projection of the transverse processes of the vertebræ on one side, and depression of the other in the lumbar region. Upon these conditions alone can the existence of rotation of the bodies of the vertebræ be determined.

Course, Duration, and Terminations.—The progress of lateral curvature is extremely variable, tending naturally towards a process of spontaneous arrest in some cases, and in others to a progressive increase, with proportionate deformity. The course depends very much upon the form and situation of the curvature, especially whether it assumes the character of the so-called 'single' or 'double' curve; descriptive terms which, though not anatomically accurate, are sufficiently so for practical purposes. The cases which naturally lead to spontaneous arrest are those in which a double curvature exists, one in the dorsal, and the other in the dorso-lumbar region, the two curves being about equal in length; whilst the cases in which a progressive increase of curvature and deformity is certain to occur, are examples of the so-called long single curve, frequently involving the whole of the dorsal, together with a portion of the lumbar region, or the whole of the lumbar and a considerable portion of the dorsal region. In cases of double curvature with a marked irregularity in the length of the curves, increase will also certainly occur, but to a less extent than in the long single curves. With regard to the duration and terminations of lateral curvature, these have already been described in the observations made in reference to the course.

Prognosis.—The prognosis will be unfavourable in proportion to the early age at which the spinal curvature commences, and the evidence of constitutional causes with hereditary tendency; and also in proportion to the inequality in the length of the curves, when double, or in cases of so-called long single curves. The prognosis will be favourable in proportion to the absence of these conditions.

Treatment.—For practical purposes all cases of lateral curvature of the spine may be arranged in three classes:—1. *physiological curves*; 2. *commencing structural curves*; and 3. *confirmed structural curves*.

1. With regard to the treatment of cases in the first class, *physiological curves*, no mechanical treatment by any form of spinal support should be given, but reliance placed entirely upon physiological means, such as gymnastic exercises, partial recumbency, and attention to the general health. In some cases an elastic brace attached to stays may be of use.

2. In the second class, *commencing structural curves*, these form the only curable cases of lateral curvature, and in their treatment the writer recommends a combination of mechanical support, gymnastic exercises, and partial recumbency. By this combination of physiological and mechanical means, the further progress of curvature will be arrested, and the best opportunity afforded for recovery from such slight structural damage as may have already occurred.

3. In the third class, *confirmed structural curves*, mechanical support of some kind must be resorted to, and continued during the period of growth, with the hope of preventing increase, and obtaining some improvement in the curvature, but confirmed lateral curvature, whether slight or severe, with its adapted series of structural changes, is essentially an incurable affection. The most efficient retentive spinal support is that form of instrument made with a pelvic belt, and spring plates attached to vertical bars at the back, without any mechanism requiring alteration by the surgeon. In some favourable cases, the stronger spinal instrument, with steel plates attached to levers, and adjusted by rack-and-pinion movements, may be used with advantage. Sayre's plaster-of-Paris jacket has been largely employed in these cases; but, from what the writer has observed in the practice of others, he disapproves of its application, on the following grounds: that it fails as a curative agent, the gain in height by extension being quickly lost; that it weakens the spinal muscles by its constant use, and hinders gymnastic exercises; that it restrains respiratory movements, and prevents active exercise; that it is an unnecessary restraint at night; and that it interferes with bathing and cleanliness. Another form of support has been recently introduced—the poroplastic jacket, which when softened by steam is applied in the same way as the plaster-of-Paris jacket during suspension, and is free from the disadvantages of the latter, as it can be removed at night, or at any time, for the purpose of gymnastic exercises. It acts as an efficient and light retentive support in many cases of incurable curvature. In this class of cases mechanical support, in whatever form it may be employed, must be combined with partial recumbency and gymnastic exercises during the period of growth; but after this period little good will be derived,

except from mechanical support, when a disposition to increase of curvature exists. When there appears to be no disposition to increase of curvature, all mechanical support should be discontinued, attention being paid only to the general health. WM. ADAMS.

**SPIRILLUM** (dim. of *spira*, a twist, a curl). This is the name given to the most important of the genera belonging to the tribe of Spiral Bacteria (*Spirobacteria*, Cohn). The three genera of this tribe are closely related to one another, as may be gathered from the citation of the characters by which, according to Cohn, they are to be severally distinguished. He describes them as follows:—*Vibrio*, 'filaments short, light, sinuous'; *Spirillum*, 'filaments short, spiral, rigid'; *Spirochæte*, 'filaments long, spiral, flexible.' The alliances between the two latter genera especially are found to be so strong that many naturalists sink the latter generic name, and include all such species under the one genus *Spirillum*.

The interest attaching to these organisms, from a medical point of view, is due to the fact that one of them, as originally discovered by Obermeier, is very frequently found in the blood of relapsing fever patients, during the first paroxysms of the disease (*see* RELAPSING FEVER). This organism is generally known as *Spirillum Obermeieri*, though some speak of it by the name of *Spirochæte Obermeieri*. In length it equals the breadth of 2–5 red blood-corpuscles (*see* Fig. 88). It is quite indistinguishable in size,

FIG. 88. *Spirillum Obermeieri*, amongst red blood-corpuscles. (After Koch.) × 700.

in general conformation, and in the character of its movements, from another form originally described by Ehrenberg as *Spirochæte plicatilis*, which is to be found in some infusions, in stagnant fresh or salt water, and (as Cohn has discovered) in the mucus about the teeth of some persons wholly free from fever of any kind (*see* SORDES). Some regard the presence of *Spirillum Obermeieri* in the blood as clear evidence that it is the cause of relapsing fever; others look upon its existence there as a mere epiphenomenon—believing, as the writer is inclined to do, that it appears as a consequence rather than as a cause of the morbid processes constituting the fever.[1]

H. CHARLTON BASTIAN.

[1] Dr. Vandyke Carter of Bombay has of late succeeded in reproducing the disease by inoculation, in certain small monkeys. But, for such a method, there was a large proportion of failures, viz. six, in twenty-one trials. Dr. Carter, in reference to this, says (*Medico-Chirurg. Trans.*, 1880, p. 125):—'The discrepancies indeed, in my experiments are marked enough to render it doubtful if the spirillum itself does represent the contagion proper, and not rather some other agency which at certain periods is associated with it.' A similar doubt was expressed by Dr. Murchison, who, when referring to the disappearance of the organisms from the blood before the crisis of the fever, their absence during the intermission, and their reappearance with the relapse of fever, said (*Path. Trans.* 1875, p. 317): 'It seems difficult to account for their appearance and annihilation twice over, except on the supposition that the soil was suitable for their development during the febrile process and unsuitable when the febrile process was complete.'

**SPIROCHÆTE.** *See* SPIRILLUM.

**SPIROMETER** (*spiro*, I breathe, and *μέτρον* a measure).—SYNON.: Fr. *Spiromètre*; Ger. *Spirometer*.

DEFINITION.—An instrument for measuring the vital capacity of the chest.

DESCRIPTION.—The object of the several instruments that have been designed for this purpose, is to measure the total amount of air expelled from the chest by the deepest expiration following upon the deepest inspiration.

All our knowledge of spirometry is derived from Dr. Hutchinson's exhaustive paper in the *Medico-Chirurgical Transactions* of 1846. The instrument designed by Hutchinson consisted of a mouthpiece and tube communicating with a gasometer of registered and graduated capacity, into which the patient breathed.

A very convenient and accurate spirometer has within the last few years been introduced by Mr. Lowne, which works on the principle of the anemometer. The advantage of this instrument is its portability.

Dr. Waldenburg describes and figures, at page 202 of his work *Die Pneumatische Behandlung, &c.*, a spirometer identical in principle with Hutchinson's, but more elaborate, and capable of being employed for the purpose of inhalation of compressed or rarefied air.

RESULTS.—The chief results of Dr. Hutchinson's labours may be thus summarised. The vital capacity varies according to *height*, *weight*, *age*, and *disease*.

(1) *Height*. There is an increase of 8 cub. in. in vital capacity for every inch in height between 5 ft. and 6 ft. Thus the vital capacity of a healthy person at 5 ft. to 5 ft. 1 in. being 174 cub. in., at 5 ft. 4 in. it would be 174 + 32 = 206 cub. in.; at 5 ft 8 in. 238; &c.

(2) *Weight*. Excess in body-weight is associated with diminished capacity in the proportion of about 1 cub. in. per lb. excess.

(3) *Age*. From thirty to sixty years the vital capacity decreases nearly 1½ cub. in. per year.

(4) *Disease*. The spirometer furnishes a very accurate standard of health or of the extent of disease, as regards the chest, the vital capacity in lung-disease diminishing from 10 to 70 per cent. R. DOUGLAS POWELL.

**SPITTING OF BLOOD.**—A popular synonym for hæmoptysis. *See* HÆMOPTYSIS.

**SPLEEN, Diseases of.**—SYNON.: Fr. *Maladies de la Rate*; Ger. *Krankheiten der Milz*.—In the *Nomenclature of Diseases* published by the Royal College of Physicians of London, in 1869, the diseases of the spleen are classified under

diseases of the digestive system. But the spleen, which is the largest of the structures known as 'ductless glands,' is not immediately concerned with the processes of digestion, and its developmental origin shows it to be unconnected with the digestive organs, although it lies in the abdomen. Its diseases ought rather to be classified with those of the other 'ductless glands,' namely, the thyroid, the thymus, and the supra-renal capsules. It is now generally admitted that the functions of the spleen are intimately connected with the work of sanguification, through certain special chemical processes (metabolic) giving rise to an assemblage of transformations of proteids, associated in some way, still unknown, with the metamorphoses of the blood-corpuscles. The spleen is most probably one of the seats of formation of the white blood-corpuscles, and of destruction of the red. It is in fact a blood-lymph-gland; and the most important indications of splenic disease are derived from the constitutional state due to extreme anæmia. This anæmia is characterised by the mucous membranes appearing pale and bloodless, the complexion and general surface waxy, earthy-like, or sallow; there is great debility and gradual wasting, characteristic dyspnœa, a tendency to hæmorrhages, general anasarca and dropsy,—phenomena which are due to the poverty of the blood, justly referable to some morbid condition of the spleen, and now generally recognised by the name of *splenic cachexia*. Another important function of the spleen, in connection with the other ductless glands, ought not to be lost sight of in the study of its diseases, namely, that it acts as a diverticulum for the accommodation of a relatively large quantity of the blood, upon which those active metabolic processes take place which constitute a special function of the spleen. Its anatomical structure eminently fits it for this. After every meal it is in a state of more or less congestion or hyperæmia, which reaches its maximum about five hours after the taking of food, and it then returns to its normal bulk. Its yielding capsule and its veins, remarkable for their large calibre and great distensibility, even when the distending force is small, sufficiently explain the rapid physiological and morbid congestions with which the organ is affected, as well as the rapid subsidence of splenic enlargements. The ductless glands, and especially the spleen, vary so much in magnitude within healthy limits, that it is difficult to state their usual weight and dimensions. The spleen may, however, be stated to range in weight in the adult from four to ten ounces avoirdupois; but in cases of enlargement weights as high as 18 lbs., 20 lbs., and even 40 lbs. are on record. In atrophic states the writer has weighed it as low as half an ounce. In relation to the body its normal weight is about 1 to 350 or 400 up to the age of forty; and as age advances, the relation becomes as 1 to about 700. It usually measures about 5 inches in length; $3\frac{1}{2}$ inches from the front to the posterior edge; and $1\frac{1}{2}$ inches in thickness. Its bulk averages from $9\frac{3}{4}$ to 15 cubic inches; and its specific weight is about 1·060.

In the following paragraphs the diseases of the spleen will be shortly noticed mainly in the order in which they have been named in the nomenclature of the College.

1. **Acute Inflammation.**—Synon.: *Splenitis.* As a *primary* affection acute inflammation of the spleen is of rare occurrence in this country. It has been known, however, to result from blows, or other kinds of accidental violence; but such injuries are more apt to cause rupture of the organ. It is mainly to the occurrence of hæmorrhagic infarctions that splenitis is due, with more or less consecutive suppuration. These infarctions occur during the course of contagious fevers; in blood-poisoning, such as pyæmia; and in valvular diseases of the heart, where vegetations of fibrin form on the valves, leading to embolism. Such infarctions are generally well-defined accumulations of fibrin in more or less rounded masses when limited and in the substance of the organ, but generally wedge-shaped when involving larger portions. The base of the wedge is towards the periphery, where it may cause an elevation of the capsule, the apex being directed towards the hilus of the spleen. The infarctions vary in size from a pea to a hen's egg; and are at first of a dark brown or brownish-red colour, and quite hard. Colour, however, is soon lost, and they become yellowish-white. A margin of acute inflammatory reaction is often well-marked round their boundaries. Under such circumstances the spleen is enlarged, and of a deep purple colour; its tissue so soft as to be easily broken down—about the consistence of coagulated blood. Pus may form, generally in one or more abscesses containing each a variable quantity; or the whole spleen may be converted into a bag of pus. Splenic abscesses have been known to open externally, into the left thoracic cavity, the stomach, the transverse colon, and the cavity of the peritoneum, where circumscribed peritonitis generally forms a limiting sac for the pus. Splenitis may also terminate by the infarction caseating, or becoming a mass of fibro-cellular substance, which, gradually shrinking up, leaves a cicatrix-like contraction on the capsular surface, in which calcification may occur. These fibrinous infarctions in the spleen correspond to the areas which mark the terminal divisions of the branches of the splenic arteries, commencing to deposit beyond where they break up into the hair-pencil-like small twigs known as *penicilli*. *Secondary splenitis* is generally the result of pyæmia or blood-poisoning, ending in abscess. Such pyæmic blocks or infarcts resemble the simply fibrinous infarcts in shape, but they are more irregular, because the process tends to extend beyond the limits of the area of the terminal twigs of the blood-vessels; and they rapidly proceed to suppuration, with inflammation of the capsule of the spleen which covers the base of the infarct, and probably due to its very septic properties. In such cases there seems to be some spontaneous local coagulation of the blood in the splenic vessels—the blood itself being morbid, as in contagious fevers such as typhus—without any evidence of embolism.

Symptoms and Physical Signs.—The symptoms and physical signs of splenitis are mainly due to the presence of, and changes associated with, infarcts. The hyperæmia and inflammation

cause the whole gland to swell. In cardiac diseases, with embola from valvular vegetations, these infarcts are generally numerous, and the swelling is therefore proportionally great, with tumefaction and some pain in the left side; and probably there is ascites and dropsy. Such splenitis may go on even to suppuration, without marked local symptoms. The enlargement of the spleen—sometimes called 'splenic tumour'—can generally be recognised by palpation, aided by percussion. Its form is that of the spleen exaggerated; and the lobulation or notching of its swollen anterior edge can sometimes be felt through the wall of the abdomen, if the patient be thin. The enlarged gland, growing, as it were, out from beneath the ribs on the left side, can sometimes be traced extending low down, as far as, and even into, the pelvic region, well over beyond the right side of the *linea alba*, and backwards towards the spine, where its margin can be separated from the mass of dorsal muscles. Its lower end can also generally be felt as a rounded edge. The tumour is movable in all directions by manipulation, change of posture, and by the act of respiration, when adhesions do not fix it. Weight and uneasiness, rather than local soreness, are present. The splenic cachexia exists; and there may occur hæmorrhages from the stomach and bowels towards the fatal end of such cases, often so profuse as rapidly to hasten dissolution.

Diagnosis.—The diagnosis of enlarged spleen, resulting from splenitis due to one or other of the causes referred to, requires the exclusion of lardaceous disease; malignant or other tumours about the cardiac end of the stomach or tail of the pancreas; such swollen conditions of the spleen as exist in Hodgkin's disease; an enlarged left lobe of the liver; and renal, omental, or supra-renal growths.

2. **Hypertrophy.**—Simple enlargement of the spleen occurs under a great variety of circumstances; but true hypertrophy, uncomplicated, and in its simplest form, is a rare occurrence, in which nothing abnormal is to be seen in the spleen or in the blood. Enlargement with hyperæmia (congestion of the spleen) occurs as a result or concomitant of pyrexia in many specific fevers—notably in enteric and malarious fevers, erysipelas and puerperal fever, pyæmia, and acute tuberculosis. The capsule of a spleen so enlarged appears very tense. The gland feels plump and elastic; but on section its substance is generally soft, pulpy, almost liquid, very full of blood, and of a dark colour. Sometimes, however, it is so firm that a more or less smooth or coarsely granular surface is shown on section, with an abundant new formation of small lymph-cells and nuclei, many of them contained in large mother cells (compound splenic corpuscles), and seen especially in the splenic pulp and vein. This condition constitutes the nearest approach to true hypertrophy, in which, with an increase in the quantity of diffuse granular matter, the enlargement is due less to hyperæmia simply than to increase of normal structural constituents. Thus the organ may attain two or three times its natural size; but the enlargement is only temporary, and subsides as the pyrexia subsides. Such simple hypertrophy sometimes results from long-continued or mechanical hyperæmia, following any obstruction to the portal circulation, or obstructive valvular disease of the heart.

The hypertrophy consequent on malaria being fully described in another article (*see* Malaria), there only remain to be noticed two special forms of splenic hypertrophy, one named by the College of Physicians as a subvariety—namely (*a*) *leucocythæmia* or *leukæmia*; and the other (*b*) a peculiar enlargement originally described by Dr. Hodgkin. but which has not been named by the College as a substantive disease. It is, however, an affection which presents such very striking peculiarities, that it requires a distinct appellation and description.

*a. Leucocythæmia.*— Leucocythæmia is fully described under its own heading; but a brief account may be given of the disease in the present article. It has a much more extended pathology than is implied by a mere hypertrophy of the spleen, although the enlargement of the spleen is almost constant. The disease is one *sui generis*, in which the number of the white corpuscles of the blood is greatly increased, with a simultaneous diminution of the red. It is generally brought about by chronic exhausting diseases, exposure to cold and wet, or such serious acute diseases as typhus fever, pneumonia, puerperal fever, or affections of the lymphatic glands; and it is almost always attended by enlargement of the spleen. The condition is generally associated with cough, diarrhœa, epistaxis, hæmorrhagic effusions, and furunculous or pustular eruptions. The increase of the colourless corpuscles of the blood, which with the enlargement of the spleen are the prominent characteristics of this disease, does not seem in any case to have occurred alone. Other and variable morbid states are always associated; or some change-producing event in the constitution, such as happens during the period of gestation and the process of parturition, precedes or coexists with the augmentation of the colourless blood-cells. The largest spleens are found in connection with this disease. There is a true hypertrophy of the organ in all its parts, so that its substance on section appears to be quite natural, although sometimes paler than usual (as all the organs are), and sometimes having a peculiar smooth lustrous appearance. Lymphatic structures also are to be sometimes seen in separate or conglomerate masses in its substance. These are composed mainly of adenoid tissue, like a congeries of splenic corpuscles or Malpighian bodies. The liver is frequently enlarged and pale. Affections of the lymphatic glands sometimes also predominate; especially in such cases as Virchow has described, where a lymphatic *diathesis* prevails, and there is a progressive inclination of the lymphatic system to the formation of lymphatic elements, while lymphatic gland-tissue tends to grow beyond its pre-existing boundaries. The liver, in such cases, as well as the spleen, contains numerous accumulations in whitish granules, or some kind of lymph tissue. This constitutes *lymphæmia*, or the lymphatic form of leucocythæmia; the other being the splenic. It may also be associated with an increase in the medulla of the bones. The causes which bring about this form of hypertrophy of the spleen, with its attendant changes in the

blood, are yet obscure; still there is sufficient evidence to show that some acute inflammatory processes may lay the foundations of the morbid state. The writer has seen the lymphatic form of the disease follow so conspicuously after exposure to cold and wet, as to leave no doubt of the relation of the disease to the exposure in the connection of effect and cause, the inflammatory swellings of the lymphatic glands commencing immediately after the exposure. There is also evidence to show that the disease may exist in a latent, masked, or subacute form for an unknown period, till the occurrence of some more acute disease, or change-producing period like child-birth, unmasks the constitutional state, after which the disease rapidly proceeds to a fatal issue. In females four cases out of ten have had their first beginnings rendered obvious after pregnancy.

Symptoms.—In the majority of cases intense 'splenic cachexia' prevails, with the usual physical signs of splenic tumour. Weight and fulness of the abdomen are the chief subjective local sensations; but transitory pains are frequently experienced there. Ascites and anasarca are usually also present. The surface of the body is pale; vomiting, diarrhœa, or constipation may prevail by turns; and jaundice is not infrequent; but diarrhœa to a considerable amount is by far the most frequent and dangerous complication, and the most difficult to arrest or control. Hæmorrhage occurs generally as epistaxis, or from the gums. The course of leucocythæmia is usually chronic, and an extreme degree of emaciation is the result; but it is not till towards the fatal issue that febrile phenomena set in, the type of which is usually hectic. In the *diagnosis* of this disease it is necessary to examine the blood microscopically, in order to demonstrate the varied increase of the colourless blood-corpuscles and diminution of the red. A single drop of blood is sufficient for this purpose, most conveniently obtained by a needle puncture of the patient's finger, the resulting drop of blood being examined under a magnifying combination of at least 250 diameters. The colourless corpuscles will then be seen to form at least a sixth, a fourth, or nearly a half of the whole number of corpuscles. A proportion of one white to ten red, or even as many as one to three, is not uncommon—an increase which gives to the blood a paler and more opaque appearance than is natural. In splenic leukæmia the white corpuscles are larger and more granular than normal. The red corpuscles may be reduced to one half, or one quarter, of the normal amount. As leukæmic blood decomposes, Charcot discovered that it contained microscopic, colourless, elongated, octohedral or spindle-shaped crystals, insoluble in water, but soluble in acids and alkalies, which he and Vulpian regarded as proteid bodies.

Prognosis.—Hitherto no instance of cure is known. All the cases have progressed to a fatal termination in about fourteen months—the minimum duration being about three months, and the maximum about four years. Death takes place gradually by asthenia and exhaustion; or rapidly from hæmorrhage or diarrhœa.

*b. Hodgkin's disease.*— The other form of splenic hypertrophy is that which has been described by the name of 'Hodgkin's disease.' It is also known as lymphadenoma. It is characterised by a peculiar white deposit or growth in the spleen, in addition to mere hypertrophy; which is sometimes also seen in the liver, kidneys, and lungs. An enormous enlargement of the lymphatic glands throughout the body, accompanied during life by a remarkable anæmia and disposition to subcutaneous œdema, are usually the earliest phenomena. The groups of glands in the order of their most frequent involvement are the cervical, axillary, inguinal, retro-peritoneal, bronchial, mediastinal, and mesenteric. The new growth is at first limited to the glands, but eventually advances beyond their capsules, so that the enlarged glands become confluent in lobulated masses, which may invade and infiltrate adjacent tissues. The disease differs from leucocythæmia in this respect, that there is no marked increase in the white corpuscles of the blood; nor has it anything to do with lardaceous disease. The enlargement of the lymphatic glands appears as the primary affection, and consists in a general hypertrophy of every part of the glands; but the exact nature of the defined white bodies which pervade the spleen is not clearly made out. Their growth commences in the Malpighian bodies. They are similar to what are found in the liver, lungs, and kidneys; and are composed mostly of lymphoid or adenoid cells imbedded in the stroma, similar to the structure of a lymphatic gland. *See* Lymphadenoma.

Symptoms.—These are indicative of general ill-health—paleness and sallowness of complexion preceding all other signs. Weakness gradually increases, the patient begins to totter on his legs, and at last is unable to walk. Sexual appetite is lost; and emaciation progresses, with marked anæmia, a pale sclerotic, and a feeble pulse. The legs finally become œdematous.

Prognosis.—The disease is eminently malignant, death usually taking place through derangement of the functions of the lymphatic system.

3. **Lardaceous Disease.**—Albuminoid disease is rarely limited to the spleen, but usually also affects the liver, kidneys, and sometimes the intestinal villi in the same patient. The trabecular interspaces, but more commonly the Malpighian sacculi, are filled with the new material, so that each corpuscle looks like a sago-grain. The spleen so affected is usually enlarged, and is specifically as well as absolutely heavier than in health. *See* Albuminoid Disease.

A lardaceous spleen implies a long-standing cachexia, and in its most intense form is seen after protracted caries and necrosis of bone, especially when associated with scrofula or syphilis; or even after external injury which leads to protracted bone-disease. Hence the question is still undecided whether lardaceous disease arises from such local sources, or is a constitutional or general disease.

4. **Cancer.**—Cancer of the spleen is extremely rare as a primary lesion. It chiefly occurs as an infective process, following generally cancer of the stomach or other viscus; or as generally disseminated encephaloid growths.

5. **Rare Diseases.**—Here it is only necessary

to mention hydatid disease, tubercle, and the splenic enlargement occasionally occurring in congenital syphilis.

Treatment.—Treatment of these diseases of the spleen by medicinal remedies is extremely uncertain, as can readily be understood from what is known of their pathology. All sources of mechanical congestion must if possible be removed or relieved. Saline purgation may be useful for this purpose; also compound jalap powder, with rhubarb, and sulphate of iron may be taken in such quantities as will produce three or four stools in the twenty-four hours. The iodides and bromides of potassium have also been recommended. The biniodide of mercury, in the form of an ointment, rubbed into the skin, has also had a beneficial effect in reducing simple splenic enlargement when not otherwise complicated. In the chronic hypertrophies, such as leucocythæmia and Hodgkin's disease, improvement of the general health is all that can be arrived at, by the employment of tonics, change of air, and attention to the hygiene of the patient. *See* Leucocythæmia; and Lymphadenoma.

William Aitken.

**SPLENIC FEVER.** *See* Pustule, Malignant.

**SPLENIZATION.**—A morbid state of the lung, in which it somewhat resembles the spleen in colour and consistence. *See* Lungs, Compression of.

**SPORADIC** (σπείρω, I scatter).—This term is used in connection with the occurrence of diseases occasionally, and in an isolated manner, amongst individuals; as distinguished from those diseases which appear endemically or epidemically. *See* Disease, Classification of.

**SPORADIC CHOLERA.** *See* Choleraic Diarrhœa.

**SPOTS.**—A popular name for eruptions on the skin. *See* Eruption; and Maculæ.

**SPOTTED FEVER.**—A popular name for typhus fever. *See* Typhus Fever.

**SPRAYS, Therapeutical Uses of.** *See* Inhalations.

**SPUTUM** (*spuo*, I spit.) *See* Expectoration.

**SQUAMÆ** (*squama*, a scale).—Scales. A synonym for scaly diseases of the skin. *See* Scaly Eruption.

**SQUINTING.** A popular name for strabismus. *See* Strabismus.

**STADIUM** (Latin, a stage).—A period or stage in a disease, as in fever; for example, *stadium incrementi*, *stadium convalescentiæ*.

**STAGNATION OF BLOOD.**—Local arrest of the circulation. *See* Circulation, Disorders of; and Inflammation.

**STAINS.**—This word, as applied to the skin, is synonymous with 'maculæ.' *See* Maculæ.

**STAMMERING.**—Synon.: Fr. *Bégaiement*; Ger. *Stottern*.

Definition.—Under the head of stammering, in its broadest sense are included many different forms of defective articulation, such as the inability, congenital or acquired, to pronounce certain letters or certain combinations of letters, the tendency to hesitate or stumble in utterance or to transpose letters or syllables, and the habit of interjecting meaningless sounds or words into the pauses which occur in the course of continuous speech. But the term is generally used, at any rate in English, as synonymous with *stuttering*, to imply a spasmodic affection of the organs concerned in speech, in virtue of which the enunciation of words becomes suddenly checked, and a painful pause ensues, not infrequently marked by a prolongation, or a repetition in rapid sequence, of the particular literal sound at which the check arises.

Ætiology.—Stammering is to some extent hereditary, although a large number of stammerers are certainly free from hereditary taint. It is sometimes imitative. The defect rarely, if ever, shows itself before the age of four or five years. Usually it comes on from this time up to the period of puberty. But it may originate at any age; sometimes after febrile disorders; sometimes in connection with nervous affections, such as epilepsy, hysteria, and tabes dorsalis; sometimes it attends mere temporary failure of health; sometimes it appears in connection with soreness or irritation of the mouth; sometimes it is induced by simple nervousness or excitement. In many of these cases the stammering is temporary only, and disappears with its cause. And as a general rule confirmed stammerers have their infirmity aggravated under similar circumstances. Occasionally, on the other hand, stammering ceases during the presence of illness. It is a curious fact that men stammer in much larger proportion than women. Cases of persistent stammering, arising in childhood, sometimes recover in the course of time; and, as a general rule, some improvement takes place after the attainment of maturity, and especially as age advances.

Description.—It has often been maintained that stammering occurs only in connection with the enunciation of the explosive consonants, that it never attends the utterance of the vowels, and that it never manifests itself during the acts of whispering and of singing. All these statements, however, though founded on fact, are more or less inaccurate. For though it is at the explosive consonants *b*, *p*, *d*, *t*, hard *g* and *k*, that stammerers for the most part come to grief, stammering is by no means uncommon during the articulation of the continuous consonants, such as *v*, *f*, *th*, *z*, *s*, *sh*, *y*, *w*, *m*, *n*, and even occurs when vowel-sounds are being produced; and though it is certainly rare for patients to stammer when whispering or singing, there are exceptions to this rule.

When stammering takes place in connection with the explosive consonants, the barriers by whose sudden opening after complete closure the several consonantal sounds are produced, instead of separating, as they should do, remain spasmodically closed; and the patient struggling to overcome the spasm, either remains, for a variable but short time, absolutely voiceless, or overcoming the resistance fitfully, utters the consonantal sound in a series of two or more successive puffs. In the utterance of *b* and *p* it is the lips which

remain closed; in the utterance of *d* and *t* it is the barrier formed by the tongue, whose tip is pressed against the superior incisors or anterior part of the palate; in the production of hard *g* and *k* it is the barrier formed by the pressure of the dorsum or root of the tongue against the posterior part of the palate.

In pronouncing the continuous consonants, the barriers at which the distinctive sounds are produced are not in absolute or uniform contact; and the consonantal sounds are continued during the passage of air through the constricted oral channel or through the nose. When, therefore, stammering attends their pronunciation, it is not due to any spasmodic closure of the parts engaged, but rather to their fixation in the natural position they have assumed, and to the frequent association therewith of more or less rhythmical attempts to close them or to separate them more widely from one another. The resulting sounds therefore either come to a full stop, or are simply prolonged or drawled, or are repeated.

In the utterance of the vowels the mouth and its appendages play only a subordinate part, and a free passage is maintained for the passage of air through the mouth. It is at the rima glottidis that the fundamental sound is produced, and it is mainly to spasm of this part that vowel-stammering is due.

But the hitch in utterance may also originate in the respiratory apparatus, and not infrequently stammering depends on a sudden inspiration or expiration, or on an arrest of the respiratory movements.

It will thus be seen that stammering may be caused by spasm of either of the three mechanisms concerned in the mechanical production of speech; namely, the mouth, wherein words are articulated; the larynx, where phonation is effected; and the respiratory apparatus, which regulates the supply of air to the organs of speech and of music. At the same time there is no doubt that stammering is far more frequently connected with spasm of the muscles of articulation than with spasm of the larynx or of the respiratory muscles, and that, of the three, respiratory spasm is the least common. Not infrequently, however, the different varieties of spasm are associated in a greater or less degree.

The degree and character of stammering differ largely in different cases. Sometimes it is nothing more than a scarcely perceptible hitch in the enunciation of a particular letter; sometimes it is so severe and continuous that the patient becomes almost unintelligible. The most distressing cases are those in which the spasm extends to parts unconnected with speech, it may be to nearly the whole muscular organism. In such a case the spasm commences, let us assume, at the base of the tongue; the mouth opens widely, and remains in that position; the muscles of expression work convulsively; the glottis contracts; respiration becomes arrested; the face becomes congested and the veins dilated; violent spasmodic movements involve the trunk and limbs; and only after some time, either when the patient becomes exhausted or he resolutely restrains his attempts to articulate, does his paroxysm come to an end. A stammerer of this kind is a truly pitiable object. Fortunately for him, however, these severe paroxysms are not always present; they increase in number and intensity under excitement or nervousness; and, on the other hand, may be replaced to a large extent in ordinary quiet conversation by merely slight hitches or drawls or reduplications of letters. A condition allied to stammering, to which the name *Aphthongia* has been given by Fleury, has been occasionally observed. It seems to be the product of intense excitement, and of temporary duration only; and to be characterised by powerful spasm of the muscles supplied by the hypoglossal nerves, including the sterno-hyoid, sterno-thyroid, and thyro-hyoid muscles, which comes on whenever an attempt to speak is made, and totally prevents speech.

Pathology.—The pathological explanation of stammering is obscure. There is no reason to believe that it depends on any discoverable material lesion, either of the organs concerned in speech, or of the nervous mechanism which controls them. It appears to be allied to a series of spasmodic affections, which have been especially studied by Duchenne, in which complex co-ordinated movements (facility in the execution of which is only attained by long practice) are concerned; such, for example, as scrivener's palsy, and the recurrent spasms which occasionally compel the skilful pianist or violinist, and the practised swordsman, to give up their pastime or avocation. Speech is pre-eminently an act of this kind. It is slowly and laboriously learnt in early childhood; and ease and accuracy of articulation are the result only of long and continuous practice. We are born with the capacity for speech, but articulate speech itself is the outcome of careful education. For its successful performance it is necessary that three distinct and complex mechanisms—the respiratory, the phonetic, and the articulatory—shall act with precision and in exact concordance; that the lungs shall be expanded at suitable intervals, and to a suitable degree, and that the force of expiration shall be regulated with nicety; that the rima glottidis shall be opened or closed according as surd or sonant letters are to be produced, and that the tension of the cords shall be accurately adjusted to the pitch of the musical tones required to be produced; and that the movements of the lips, jaws, tongue, and soft palate shall be accurately adjustable for each literal sound, and capable of passing from one set of adjustments to another with rapidity and smoothness. Of all these co-ordinated movements, those connected with articulation are the most various in their grouping, the most rapid in their changes, and the latest learnt. It is natural, therefore, that the hitch or spasm interrupting speech should occur mainly in connection with these, and mainly, if not exclusively, at the instant of passing from one literal sound to another; that is to say, at the moment of transition from one set of muscular combinations to another set. It is natural too that the laryngeal or the thoracic spasm should occur rather in association with articulation than at other times; inasmuch as the movements are more various and intricate during articulation than they are during ordinary respiration, or even than they are in the production of musical notes, as in

singing. In the last case the laryngeal changes, though extremely delicate and exact, are mainly of one kind only, dependent, namely, on variations of tension in the vocal cords.

Treatment.—In dealing with cases of stammering it is necessary in the first place to counteract, or cure, if possible, any affection of the mouth or throat, or any general disorder that may be present, which are frequent causes of temporary stammering, or of aggravation of habitual stammering. Assuming, however, that the patient is in other respects in absolutely good health, what can be done? Many kinds of medical treatment have been practised, and even operative measures; but, as far as the writer knows, without beneficial result. The only methods, indeed, of any real efficacy, are educational methods. The patient should be taught to practise slow and deliberate utterance, and whenever the tendency to stammering occurs in connection with any letter, to check himself momentarily by voluntary effort, and then to try again, rather than to struggle against his defect. He should, moreover, be taught to accustom himself so to regulate the admission of air into his chest during speech, that his utterance may never fail for want of breath. Further, considering that excitement and nervousness always aggravate stammering, he should learn, as far as possible, either to avoid speaking under these conditions, or to restrain excitement and nervousness, or so to control himself as to speak with special care and deliberation when he is thus affected. These measures should not only be observed in ordinary conversation, but be habitually and systematically practised in reading aloud; and especially those sounds, or those combinations of sounds, or those transitions from one sound to another, which are most difficult for him, should be made the subject of careful and constant study. By such means habitual stammering is occasionally cured, or if not cured, so far kept in abeyance that an occasional momen tary pause in speech is the only surviving indication of it that the practised ear can detect. More frequently, however, the stammerer remains a stammerer, either because he has never had the patience and determination which are necessary to carry out the line of treatment above indicated, or because his infirmity is one for which treatment is unavailing. By taking advantage of the well-known fact that stammering almost always disappears during singing, many stammerers have been able to counteract their defect by intoning. This method has proved of special efficacy in the cases of clergymen and other public speakers.

J. S. Bristowe.

**STAPHYLOMA** (σταφυλή, a bunch of grapes).—Synon.: Fr. *Staphylôme*; Ger. *Staphylom.*—This word was applied by old writers, in the jargon which was once supposed to be scientific, to any limited protrusion of the tunics of the eyeball. It was first used to denote the protrusion which occurs in the circum-corneal sclerotic zone, as a consequence of localised inflammation of this region. The tissue affected by the inflammation in such a case becomes softened, yields to the intra-ocular tension, and projects; but being restrained by bands of lymph, or by thicker portions of its own structure, from projecting uniformly, the prominence becomes more or less sacculated; and the most prominent portions, being thinner than the rest, and permitting the dark pigment of the interior of the eye to show through, present an appearance which may be compared to that of a miniature bunch of purple grapes—a real or fancied resemblance from which the term 'staphyloma' was derived. This form has more recently been termed 'staphyloma of the sclerotic,' to distinguish it from 'staphyloma of the cornea,' which is the protrusion left when the corneal tissue has been destroyed by ulceration, either wholly or in part, and the resulting cicatrix, formed of iris-tissue coated over by lymph, yields to the pressure of the fluids within the eye and becomes prominent. *Corneal staphyloma* is described either as partial or complete, according to the amount of cornea which is replaced by cicatrix.

*Staphyloma posticum* is a phrase applied to that protrusion of a circumscribed portion of the sclerotic, in the immediate vicinity of the optic nerve, which occurs in some cases of myopia; and which, by increasing the elongation of the eyeball, increases also the degree of the short sight. It would be highly desirable to abandon the term 'staphyloma' in favour of 'protrusion,' with such appended words as might serve to indicate the place and nature of the change. *See* Eye and its Appendages, Diseases of.

R. Brudenell Carter.

**STARVATION** (Sax. *Stearfian*, to perish). This term is generally applied either to deprivation of food, or to the series of phenomena to which such want gives rise. The word is often used synonymously with *fasting*, which, however, may be more accurately applied to voluntary starvation. *See* Fasting.

**STASIS** (στάω, I stop).—Local arrest of the circulation. *See* Inflammation.

**STATISTICS, Medical.**—This term signifies the collection of numbers respecting healthy and morbid processes, and respecting disease and death; the application of arithmetical and algebraical operations to such numbers; and the deduction of conclusions therefrom.

But little use of statistical methods was made in medicine before the present century; and much of the progress that science has recently made is largely to be ascribed to the direct use of such methods in pathology, ætiology, and therapeutics, and to the indirect influence they have had in promoting accuracy of thought.

The value of statistics depends upon the complete uniformity of the facts observed, and upon the accuracy with which the observations are made. It may be well here to remember the words of Rousseau, quoted by M. Louis: '*Je sais que la vérité est dans les choses et non dans mon esprit qui les juge, et que moins que je mets du mien dans les jugements que j'en porte, plus je suis sûr d'approcher de la vérité.*'

In England much use of statistics has recently been made in the investigation of the causes of disease among communities. *See* Morbidity;

MORTALITY; PERIODICITY IN DISEASE; and PUBLIC HEALTH. G. B.

**STEARRHŒA** (στέαρ, fat, and ῥέω, I flow).—SYNON.: Steatorrhœa.

DEFINITION.—A flux of the fatty secretion of the skin. By an ungrammatical combination of the Latin *sebum* with the Greek verb, it is sometimes written *seborrhœa*.

ÆTIOLOGY.—An ill-nourished or debilitated condition of the skin must be regarded as the cause of this affection; the debility being sometimes temporary, as in young persons, and sometimes permanent, as in the elderly.

DESCRIPTION.—Like other secretions, that of the sebum of the sebaceous glands and follicles is liable to excess. It is sometimes diffused over the surface, forming a greasy stratum, and sometimes accreted in laminæ of various extent. This is the *stearrhœa simplex*, an affection most commonly met with on the face.

The excessive secretion in its normal state is colourless, but occasionally it is stained with melanic or biliary pigment; hence the terms *stearrhœa nigricans* and *stearrhœa flavescens*. Sometimes, as in elderly persons, the epithelial element of the secretion prevails over the fatty element, and in that case it is apt to adhere closely to the epidermis. In the latter case the concretion may be accompanied by excoriation, and sometimes by asthenic ulceration, of the skin.

DIAGNOSIS.—Stearrhœa is so obvious in its nature as to be unlikely to be confounded with other affections of the skin. It is sometimes associated with acne; and, in certain cases of excessive accumulation, has been denominated 'ichthyosis.'

PROGNOSIS.—Stearrhœa is an affection which admits of immediate relief, and is generally curable. In elderly persons, however, it is sometimes the precursor of epithelioma of the skin, or of rodent ulcer.

TREATMENT.—The abundant use of soap as a detergent, followed by the application of a lotion of lime-water with oxide of zinc and calamine, very speedily exerts a favourable influence on the skin. Concretions may be softened previously to removal, by pencilling with olive oil, or by inunctions with vaseline. And where the encrusting laminæ are incorporated with the epidermis, a cold starch-poultice, made as starch is ordinarily prepared, may advantageously precede other curative operations.

In both young and elderly persons it will be necessary to improve the general health, which is usually defective. And it may be found desirable to conclude the treatment by the administration of three minims of liquor arsenicalis three times a day, as a neuro- and nutritive tonic. ERASMUS WILSON.

**STEATOMA** (στέαρ, fat, and ὁμός, like).—SYNON.: Fr. *Stéatome*; Ger. *Steatom*.—An atheromatous cyst. *See* CYSTS.

**STEATOZOON** (στέαρ, fat or sebum, and ζῷον, an animal).—The terms *Steatozoon* and *Entozoon folliculorum* were given by Sir Erasmus Wilson to the microscopic animalcule called by Gustav Simon *Acarus folliculorum*, and by Owen *Demodex folliculorum*. *See* ACARUS.

**STENOSIS** (στενόω, I constrict).—A constriction, narrowing, or stricture of an opening or a tube; for instance, *mitral* or *aortic stenosis*, in the heart; and *stenosis of the œsophagus*.

**STERCORACEOUS** (*stercus*, dung).—Fæcal; a term generally applied to vomited matter, when it presents the characters of fæces. *See* VOMIT.

**STERILITY IN THE FEMALE.**—SYNON.: Barrenness; Fr. *Stérilité*; Ger. *Unfruchtbarkeit*.

DEFINITION.—Want of the power of reproduction in the female.

FREQUENCY.—In the general community the proportion of childless marriages seems to be about 1 in 8, or 8·5; among members of the peerage 1 in 6·11. Whether Kehrer be correct in estimating that the husband is in fault in at least one-fourth of the cases of *sterilitas matrimonii* remains to be proved. Doubtless he is nearer the truth than those who attribute the sterility in nine cases out of ten to some fault in the wife, because whilst the comparatively rare cases of male impotence are readily enough recognised, and also the rarer cases of *aspermatism*, the cases of *azoöspermatism*, where an azoic semen is ejaculated, are for the most part altogether overlooked. The possibility that the cause of the childlessness may be found in the male must, therefore, always be borne in mind. But we confine ourselves here to the consideration of sterility in the female. *See* IMPOTENCY; and STERILITY IN THE MALE.

ÆTIOLOGY.—For generation the essential product in the female is the ovum; and in her reproductive apparatus we find (i.) *oviparous organs* for its production; (ii.) *oviducts* for its transmission; (iii.) an *ovigerent organ* or nest in which the ovum is hatched; and (iv.) *copulative organs* for the reception of the semen, the spermatozoa of which constitute the essential contribution of the male. In a married woman in whom the generative function is in abeyance, the sterility may be primitive or acquired. In the former case we have to do with a female who has never borne a child; in the latter the woman may have borne one or more children, but has for some years ceased to conceive. In either case we search for the fault in one or more of these four planes of her sexual apparatus.

**I. Faults in the ovaries.**—The ova are developed in the ovaries, and the conditions which interfere with ovulation—that is, the regular ripening of an ovisac, and the discharge of an ovum—diminish or destroy the possibility of conception. Such conditions are found in:—

1. *Absence* or *imperfect development*.—Cases of absence or defective development of the ovaries are rarely met with, except in women in whom the rest of the sexual apparatus is also anomalous.

2. *Displacements*.—One or both ovaries may be found displaced. Instead of lying at the level of the pelvic brim, they have fallen into the pouch of Douglas. In this position, though the ripening and dehiscence of the ovisacs may be

duly taking place, the discharged ova are not received into the free extremity of the Fallopian tube. The displaced ovary, moreover, is extremely likely to be the seat of some degree of inflammation.

3. *Inflammation.*—Oophoritis, acute or chronic, lessens the conception-power in various ways. It may lead, 1st, to destruction of the follicles, so that no ova are produced; 2ndly, to condensation of the stroma, so that the regular ripening of the ovisacs is impeded; 3rdly, to deposits on the surface, which prevent the dehiscence of the ovisacs; or, 4thly, to adhesions of the ovary, in situations which hinder the entrance of the discharged ova into the oviducts.

4. *Degenerations.*—The neoplastic degenerations to which the ovaries are most liable are the cystic; and all the varieties of cystomata, as well as the fibromata, the sarcomata, and the carcinomata, are commonly attended with sterility. Where both ovaries are affected the sterility is absolute, from the complete loss of function in the organs; and even where only one is affected, the disturbance in the relations of the pelvic organs, caused by the growing mass, is likely to prevent impregnation. *See* OVARIES, Diseases of.

II. **Faults in the oviducts.**—The Fallopian tubes or oviducts serve not only for the reception of the discharged ova, and their transmission downwards to the uterus; they serve also for the upward transit of the spermatozoa. In most cases it is probably somewhere in their canal, perhaps towards the free extremity, that the male and female elements come into union.

1. *Absence.*—Defective development of the Fallopian tubes is usually associated with other abnormalities of the sexual apparatus, especially with rudimentary conditions of the uterus.

2. *Inflammation.*—Inflammatory changes may be found affecting either the external serous covering, or the internal mucous lining. In the former case sterility results from adhesions, which lead to displacements of the free extremities, so that they are not in a position to receive the ova discharged on the bursting of an ovisac; or from bands which constrict the tubes, and so occlude their canal. In the latter, changes in the secretion may prejudice the vitality of the spermatozoa or ova; or the thickenings, polypoidal or other, may obstruct the canal; or complete atresia may be produced, and their permeability be thus entirely lost. *See* FALLOPIAN TUBES, Diseases of.

3. *Degenerations.*—The tubes are rarely enough the seat of neoplasms; but when such do develop in their walls, occlusion of their canal and consequent loss of function may ensue.

III. **Faults of the uterus.**—In the process of reproduction, the uterus serves as the receptacle or nest, in which the fertilised ovum is carried during the period of incubation. In its proliferating mucous membrane the chorionic villi take root; through its expanded blood-vessels the fœtal blood is brought into relation with the maternal; its walls grow in correspondence with the increase in size of the ovum; and its largely developed muscular fibres are the main agents in the expulsion of the ovum when it is finally hatched. It plays such an important part in the female economy that the name of it is often used as synonymous with the sexual apparatus; and some of its morbid conditions are among the commonest causes of sterility.

1. *Defective development.*—First, it may be *absent* altogether, or represented merely by a fibrous nodule. Secondly, it may be *small*, having undergone arrest at some stage of its growth, and remaining infantile, juvenile, or adolescent. Thirdly, it may be *bicornuous*—retaining the trace of its original duplicity by the presence of a septum running through the body alone, or running through both body and cervix, perhaps through the vaginal canal as well. Fourthly, it may be *unicornuous*—only one of the halves of the organ having been developed, while the other tube may be obliterated, or attached as a rudimentary by-horn to the better developed tube. Fifthly, a more frequent malformation is found in a *conical* form of the *cervix*, which is not infrequently complicated with, sixthly, *narrowness of the os.* This last condition may exist by itself, forming a well-recognised cause of sterility, and furnishing some of the cases in which a most satisfactory cure can be accomplished.

2. *Displacements.*—First, *descent* of the uterus is found as the predominant morbid condition in some cases of sterility, but this is more frequently associated with the deviations anteriorly or posteriorly. Of these, secondly the *antroversions*, flexion and version, are very frequent among women who have never conceived at all; thirdly, the *retroversions*, flexion and version, are more common in women who have given birth to one or more children, and have subsequently remained sterile. The flexions, in particular, form a very clearly recognisable and often remediable cause of sterility.

3. *Changes in size.*—The retrogressive changes which occur in the uterus after labour sometimes go on morbidly, and in one group of cases leave the organ in a condition of, first, *super-involution.* The uterus may be reduced to a little tube which only admits the sound for half an inch. Even when the degree of super-involution is less, and it still measures two and a quarter inches in length, it is apt to cause amenorrhœa and sterility. In another group of cases the uterus remains hypertrophied in a condition of, secondly, *sub-involution*, which is inimical to conception; and when conception does take place in such a uterus, abortion is liable to occur.

4. *Inflammation.*—Among the commonest causes of sterility must be ranked the inflammatory changes to which the uterus is so liable, whether the process have affected mainly the external, middle, or internal coat; and in many of the cases where some other condition tending to sterility is present, inflammatory changes come in to increase the difficulty, and to cloud the prospects of recovery. First, *perimetritis* is usually only an element of a more general pelvic peritonitis, which often leaves behind it fixations and displacements of the uterus, preventing conception or promoting early abortion. Secondly, *mesometritis*, leading to thickening of the walls of the organ, produces an expansion of its cavity and disturbance of its function. It is rarely possible to dissociate it from, thirdly, *endometritis*, which is attended also with dilatation of the cavity, but which is further mischievous from the deleterious influence of its abnormal secretions on the life

and progress of the spermatozoa, and from the difficulty with which a fertilized ovum gets healthily engrafted on its surface. Moreover, in certain cases of long standing, some of the uterine orifices may become more or less occluded, a result which is more especially apt to ensue in the external orifice when caustics have been applied to the cervical canal.

5. *Degenerations.*—First, *myomata*, or fibroid tumours, are found in a considerable proportion of barren women. Whether sub-peritoneal, intra-mural, or sub-mucous, they interfere in many ways with conception, and give a proclivity to miscarriages or dangerous, labours when conception has occurred. Secondly, *sarcomata* have usually their seat in the uterine cavity, and seem to be an absolute bar to impregnation. Thirdly, *carcinomata* have been sometimes met with in the pregnant uterus; but these are commonly seated in the cervix, and it is usually only in an early stage of the mischief that conception can occur. *See* Womb, Diseases of.

IV. **Faults in the external organs.**—In various ways the organs which serve for the reception of the spermatic fluid may be so affected that their copulative function is disturbed or destroyed, and the patient remains sterile.

1. *Malformations.*—Occlusions of the labia are rare; but the vaginal canal may be impervious, firstly, from abnormal conditions of the *hymen*; secondly, from *atresia* in some part of its course; or, thirdly, from complete *absence*. Even it will be found that in certain cases where the rest of the generative apparatus seems to be well-developed, a preternatural *shortness* of the canal is found in some sterile women, from whom the semen escapes immediately after it is thrown into the cavity.

2. *Injuries.*—The injurious influences of a bad labour on the reproductive power of a woman may be found, first, in an undue *patency* of the canal, usually from extensive rupture of the perinæum; secondly, more frequently from *atresia*, partial or complete; or, thirdly, from *fistulous* formations, leading to communication with the neighbouring cavities.

3. *Inflammation.*—In its acute stages, inflammation of the pudenda and vagina produces, first, *dyspareunia*; in its more chronic forms it may be productive of, secondly, *unhealthy discharges*, which endanger the vitality of the spermatozoa; or it may lead, thirdly, to *occlusions* of the labia, or of the vaginal orifice or canal. Partly of inflammatory origin is the condition, fourthly, of *vaginismus*, which is not an uncommon cause of impossible connection.

4. *Degenerations.*—The various neoplasms occur with rarity in the vaginal canal; but in the pudenda—sometimes from their bulk, sometimes from their sensitiveness—they interfere with connection, as in cases of elephantiasis labiorum or of urethral caruncle.

Diagnosis and Prognosis.—Investigation into a case of sterility may require that we satisfy ourselves as to the fertilizing powers of the male, and the due fulfilment of the marital function. Occasionally some concurrent disturbance in the functions of the sexual apparatus of the female, or of the neighbouring organs, may enable us to make a close guess at the cause of her barrenness; but we can only arrive at a true conclusion by a careful physical examination, having in view such a *vidimus* of causes as we have given. Some of the conditions, such as the more pronounced malformations, or imperfect development, make us regard her as hopelessly sterile. others, such as uterine flexions and stenosis, and some vaginal occlusions and injuries and tenderness, we may undertake to treat with good hope of fruitful result. *See* Vagina, Diseases of.

Treatment.—In commencing the treatment of any case we must bear in mind that morbid conditions may be present in more than one of the planes of the sexual system, and that we must begin with the removal of the obstacle that lies nearest the surface. Urethral caruncles and other sensitive structures in the vulva must be cut off or cauterised. Contractions of the vaginal orifice or canal must be stretched; and where there is complete atresia an aperture must be formed and kept patulous. Stenosis of the uterine orifices may be overcome by temporary dilatation with a tangle-tent, which the writer has more than once seen followed by impregnation. Where such dilatation fails, the os may be dilated more permanently, by tearing it with an instrument like a pair of long dressing-forceps, the blades of which are forced apart after it has been passed into the cervix; or by dividing the cervix at both sides, or in one or other lip, with a hysterotome. The deviations of the uterus must be rectified; versions, after replacement, being usually retained by some modification of Hodge's pessary; flexions demanding in addition the use of an intra-uterine stem. The stem-pessary of zinc and copper introduced into the interior, is the best means of stimulating to its full function the imperfectly developed uterus, and the uterus which has withered from super-involution. Morbid conditions in the interior of the uterus require direct applications to its cavity. And, as in a large proportion of the cases, some inflammatory mischief complicates the other morbid condition, it is often helpful to the cure to make the patient use hot douches and baths, and the internal remedies which tend to remove the effects of inflammatory action. It is to the beneficial influence which the waters of Ems, Aix, Kissingen, and other spas exert on chronic metritis, that their reputation for curing sterility is mainly due. In cases where the natural method of getting spermatozoa brought into relation with the ova has failed, success is said to have followed the introduction of seminal fluid by means of a fine syringe and tube into the cavity of the uterus—a line of treatment legitimate, it may be, but only to be followed in quite exceptional circumstances.

Alexander Russell Simpson.



**STERILITY IN THE MALE.**—Synon.: Fr. *Stérilité chez l'homme*; Ger. *Unfruchtbarkeit des Mannes.*—Sterility in the male has been confounded with impotence, no distinction having been drawn between inability to procreate and incapacity for sexual intercourse. A man may, however, be subject to *sterility*, independently of *impotence*. *See* Impotence.

Description.—Sterility may arise from the following causes:—1. malposition of the testicles·

2. obstruction in the excretory ducts of the testicle; 3. impediments to the ejaculation of the seminal fluid; or 4. *aspermatismus* or non-ejaculation.

1. *Malposition of the testicles.*—A testicle which does not pass into the scrotum is nearly always small in size, and often undeveloped, not having undergone the enlargement and change in structure which takes place at puberty. A testicle thus detained fails in some animals, as well as in man, to secrete a fertilising fluid; and a male with this defect on both sides, though often potent and efficient for sexual intercourse, is incapable of impregnating the female. Many striking cases illustrating this point have come under the notice of the writer, cases of persons with retained testes, who have married without their wives becoming pregnant, and in whom the fluid emitted in coition has been destitute of spermatozoa—*azoöspermatism.*[1] The facts which have been adduced as opposed to the conclusion that cryptorchics are sterile, are chiefly instances in which they are reputed to have procreated children; but it is remarkable that as yet no case has been found in which a retained testicle has been fully proved to be capable of secreting a fertilising fluid. Spermatozoa have been found absent in every case of retained testicle, without exception, in which search has been made for them.

2. *Obstruction.*—The lymph exuded in the cavity and walls of the excretory duct of the testicle in epididymitis, is liable to produce obstruction of the canal. This may be only temporary, the lymph becoming absorbed under treatment. Where the obstruction is complete and permanent, an induration is left in the tail of the epididymis; and when this exists on both sides, sterility is the result. Many curious cases of sterility from this cause have fallen under the writer's observation.[2] They show the great importance of steadily prolonging the treatment of epididymitis, until the enlargement and induration of the part have disappeared. The excretory duct of the testicle is liable also to be interrupted by tubercular deposits in the epididymis. Sterility from this cause in persons with double tubercular disease of the epididymis is not uncommon.

3. *Urethral impediments.*—A close stricture in the urethra so completely interrupts the passage of the seminal fluid, that in ejaculation it regurgitates into the bladder, where it mixes with the urine. This is a condition which is remediable by the cure of the stricture.

4. *Aspermatismus.*—Sterility sometimes arises from a cause which has been expressed by the term *aspermatismus*. Thus, it is essential to the complete performance of the sexual act, that the local excitement should culminate in the reflex action of expelling the collected semen. Unless this takes place coition is unsatisfactory and fruitless. There are cases of men who never experience ejaculation, even after prolonged coitus, though they are subject to nocturnal emissions. This appears to arise in some instances from defective sensibility in the glans penis, which the writer has endeavoured to correct by the application of the acetum cantharidis to the glans, and by electro-magnetism. In one case of non-ejaculation, the nerves proceeding to the glans appear to have been destroyed by a syphilitic ulcer on the dorsum penis, or to have been compressed in its cicatrisation.

Conclusion.—The question may arise whether a man who has the inclination and power to copulate, but who is nevertheless sterile, is justified in contracting marriage. That a man who is unable to fulfil the command, 'to be fruitful and multiply,' is right in disappointing the hopes and perilling the happiness of a woman cannot, in the writer's opinion, be maintained; and he has felt it his duty to give advice in accordance with this opinion.

T. Curling.

[1] For detailed evidence on this subject, see *Treatise on Diseases of the Testis*, by the writer.

[2] *Vide lib. cit.*

**STERNUTATORIES** (*sternuo*, I sneeze). Synon.: Errhines; Fr. *Sternutatoires*; Ger. *Niesmittel.*

Definition.—Remedies which cause sneezing, and produce an increased secretion from the mucous membrane of the nose.

Enumeration.—The principal sternutatories are Tobacco Snuff, Veratrum album, Euphorbium, and Ipecacuanha.

Actions and Uses.—The action of these drugs is simply one of stimulation and irritation of the part to which they are applied; and the slight amount of gentle excitement furnished by snuff has ensured a very wide popularity for this preparation of tobacco.

White hellebore causes almost uncontrollable sneezing when incautiously inhaled, and powdered ipecacuanha-root is well known to cause excessive irritation in exceptional cases. No use is now made of these therapeutical actions, and it seems hardly necessary to retain the term sternutatories any longer in our nomenclature.

R. Farquharson.

**STERTOR** (*sterto*, I snore).—Synon.: Fr. *Sterteur*; *Ronflement*; Ger. *Schnarchen*; *Röcheln.*

Definition.—A term commonly applied to sounds in the throat resembling snoring, which occur in the apoplectic and like conditions. In this article the writer would extend the name to other sounds formed in any part of the respiratory passages or mouth by the movements of the air, under the like circumstances.

Varieties.—Several varieties of stertor may be recognised, as follows:—

1. *Nasal.*—Nasal stertor arises from approximation of the alæ nasi towards the septum by the ingoing air, as in the act of sniffing.

2. *Buccal.*—This form of stertor is due to vibrations of the lips, and puffings and flappings of the cheeks during inspiration or expiration.

3. *Palatine.*—Arises from vibrations of the soft palate, whether the breath passes through the mouth or the nose.

4. *Pharyngeal.*—Pharyngeal stertor is caused by the lolling back of the base of the tongue into near contact with the posterior wall of the pharynx.

5. *Laryngeal.*—This variety is referable to vibrations of the chordæ vocales.

6. *Mucous.*—Mucous stertor is a term which

may be given to the bubbling of air through mucus in the trachea or larger air-tubes.

Ætiology.—One or more of the varieties of stertor, in varying degrees of intensity, may occur in any of the following morbid conditions, namely:—Suffocation; epilepsy; convulsions in children; the death-agony; fractures of the skull, and concussion of the brain; bronchitis—particularly that of the old, sudden œdema of the lungs, and large hæmorrhages from the lungs; great exhaustion; chloroform-poisoning, drunkenness, and opium-poisoning; drowning, and all conditions in which mucus or fluid exists in the lungs; and all forms of sopor, whether natural or the result of accident or disease.

Description.—The general phenomena of stertor are those of suffocation.

A patient may be found lying in a state of complete unconsciousness, with a congested, turgid, and expressionless face; usually dilated and fixed pupils; insensitive conjunctivæ; a hot and perspiring skin; throbbing arteries; a full and bounding pulse; and, lastly, noisy breathing, the direct result of mechanical interference with the passage of air into or out of the lungs, whether arising from contractions of the orifices, and vibrations of the soft parts of the nose, lips, cheeks, palate, pharynx, and larynx, or from mucus in the trachea and bronchial tubes. When the obstruction to the breathing is only slight, but long-continued, the face may be of a dusky pallor, and there is an entire absence of turgidity and congestion.

Pathology.—All the varieties of stertor, whether manifested singly or in combination, have been usually regarded, especially in the case of apoplexy, as symptoms essentially and mysteriously connected with the primary disease. This is not the true account of them. Whatever may be the original cause, these symptoms only indicate a varying amount of obstruction to respiration, sometimes so great as to be fatal in itself, but only as a secondary and, so to speak, accidental consequence of the primary disorder. Stertor is, in fact, 'suffocation.' In its effects it may be compared with croup, and being equally dangerous it may equally require relief. But even buccal stertor, which many authors have looked upon as of so grave importance, may not unfrequently be observed in ordinary sleep; and the writer has seen recoveries from apoplexy, in which at different times all the forms of stertor have been present. Stertor in apoplexy being, then, apoplexy *plus* suffocation, the whole subject, as regards diagnosis, prognosis, and morbid anatomy, must be approached from a new point of view. The congested and turgid face, the noisy breathing, the râles in the chest, the throbbing arteries, and the full and bounding pulse, which are the generally received symptoms of sthenic apoplexy, and which have been regarded as indicating the adoption of venesection and active remedies, are neither more nor less than signs of suffocation. Immediately upon the removal of obstructions to the breathing, all these symptoms disappear, and with them the necessity for active treatment. Long ago Heberden and Fothergill questioned the propriety of bleeding in such cases, and the latter thought that these violent symptoms arose from an exertion of the *vires vitæ* to restore health; whereas they really indicate a struggle to overcome an impediment to respiration and circulation. Directly this impediment is removed, all is quiet in apoplexy, and the practitioner is enabled to judge of the real state of the case—which side is paralysed, whether the nerves are losing or recovering their power, and what evidences exist as to greater or less interference with the functions of organic life.

Treatment.—In stertor, as in strangulation, we must proceed at once to remove the impediment to free respiration.

*Nasal stertor.*—This may be relieved by pressing upwards the tip of the nose, or by keeping the nares open by the handle of a common salt-spoon.

*Laryngeal stertor.*—This never appears dangerous enough to warrant tracheotomy, which alone would remove it.

*Buccal, pharyngeal, palatine, and mucous stertor.*—These varieties of stertor are readily treated by placing the patient comfortably on one side, and affording support by well-arranged pillows. In this position the buccal and palatine stertor, if any remain, will be too feeble an impediment to require further attention. The tongue drops to the side of the pharynx, and leaves plenty of room for the ingoing air. The mucus or fluid, too, whether resulting from these or other forms of stertor, drains away into the lowermost lung, thus preventing the formation of large foam-vesicles in the trachea (the 'death-rattles'), which are always dangerous respiratory impediments. Care should be taken to keep the neck rather straight, as, if the chin be brought too near the sternum, the thyroid cartilage presses upwards and backwards, and pushes the base of the tongue towards the back of the pharynx. In the management of mucous stertor it must be observed that, after a time, varying from one day to three or four, the lower lung becomes filled with mucus, though the patient is still breathing quite placidly. If at this stage the patient be turned over on the other side, the mucus begins travelling across the trachea into the opposite lung; is caught on its passage by the ingoing air; and is whipped into foam, which at once blocks up the larger air-tubes of the only lung that can work, and so instant distress and danger result. If the life of the patient be not at once destroyed, still the additional shock reduces very much the chances of ultimate recovery. Under these circumstances change of position should always be tentative, and time for some return of nerve-vigour should be allowed before it is attempted. This warning applies with equal force to all cases where mucus or fluid obstructs the air-passages, as in drowning and bronchitis. In drowning, it may be remarked that the water, on entering the lungs, becomes quickly inspissated with mucus, forming a milky foam, which can only be slowly evacuated by the application of Dr. Marshall Hall's or other process of artificial respiration. *See* Artificial Respiration; and Resuscitation.

Robert L. Bowles.

**STETHOGRAPH** (*στῆθος*, the chest, and *γράφω*, I write).

Definition.—An instrument for recording the movements of the chest.

The indices in stethometers are adapted to record maximum expansion at any one point. Dr. Sanderson's 'recording stethometer,' described and figured in the *Handbook to the Physiological Laboratory*, consists essentially of a tympanum, on one side of which a knob is fixed, for application to the chest-surface. This tympanum is in communication with a second tympanum by means of an air-tube, and the fluctuations of the second tympanum are recorded by a writer upon a revolving surface of paper. By means of this instrument, properly adjusted, the respiratory movements of the chest at any point can be recorded, as regards both depth and rhythm.

R. Douglas Powell.

**STETHOMETER** (*στῆθος*, the chest, and *μέτρον*, a measure).—Synon.: Fr. *Stéthomètre*; Ger. *Stethometer*.

Definition.—An isntrument for measuring the mobility of the chest, and of its several parts, during respiration.

Description.—Various forms of stethometer have been designed. Dr. Sibson's 'chest-measurer' consisted of a simple arrangement by which a rod, attached by a movable rack to an index, might be applied vertically in succession to different parts of the chest (*see Sibson's Collected Works*, vol. ii.) Dr. Quain's stethometer consists of a cord attached to an index working on a graduated dial (*London Journal of Medicine*, Oct. 1850). Expansion on the two sides may be measured and compared by means of the double tapes, or the soft metal cyrtometers, held so that the ends overlap in the median line. A more elaborate instrument is that of Dr. Ransome, who has with it made valuable observations on the respiratory movements (*Med.-Chir. Transactions*, vol. lxiv. p. 185).

R. Douglas Powell.

**STETHOSCOPE** (*στῆθος*, the chest, and *σκοπέω*, I examine).—Synon.: Fr. *Stéthoscope*; Ger. *Stethoscop*.

Definition.—An instrument employed as a medium for the conduction of sound, between the ear and the chest or other parts, in auscultation.

Description.—Stethoscopes are of various patterns. They are commonly made of a thin, cylindrical piece of wood, perforated through its length, which is of about 6 in. to 8 in.; expanded at one end to a somewhat trumpet-like extremity, for convenient application to the chest; and at the other end provided with a flat, broad surface, to which the ear can be comfortably applied. Some practitioners prefer a solid stethoscope—that is, one in which there is no central canal. Others prefer the stethoscope to be made of metal; others, again, of vulcanite. An instrument made of cedar wood, with a perforation of about $\frac{2}{10}$th in. in diameter, a chestpiece about $1\frac{2}{10}$ in. in diameter, and a slightly concave earpiece $2\frac{1}{2}$ in. to $2\frac{3}{4}$ in. in diameter, is perhaps the best adapted for auscultation.

Some auscultators at the present day use the *binaural stethoscope*, which consists of a short hollow chestpiece, of an elongated conical shape, from which two flexible tubes, formed of wire coils covered with felt, extend, terminating in metal tubes tipped with ivory, to fill the meatus of the ear on each side. This instrument has some advantages. It can be more readily applied to different parts of the chest without the observer being obliged to adopt constrained postures; and by occupying both ears whilst the chestpiece is applied, it excludes extraneous sounds, and considerably intensifies the chest-sounds. The disadvantages are, that sounds produced in the mouth and throat of the patient, which would be recognised by the disengaged ear of an observer using the ordinary stethoscope, are apt to be mistaken for modified pulmonary sounds. Again, with the aid of the ordinary stethoscope impulses of various kinds, cardiac or aneurismal, not recognisable on ordinary palpation, are very appreciable by the ear, which might escape attention with the binaural instrument. Intensification of auscultatory signs, also, whilst perhaps an advantage in the common run of practice, is not so to persons learning auscultation, and whose hearing is not defective.

The *differential* stethoscope, which is a binaural stethoscope having the tube connected with each ear attached to a separate chestpiece, is useful in some cases of heart-disease, and for simultaneously comparing the two sides of the chest—provided the two ears of the observer are of equal auscultatory power. Finally, some practitioners prefer a single flexible tube, with an earpiece fitting into the meatus, and a chestpiece. It has been attempted to apply the telephone, and even the microphone, to stethoscopy, but as yet without success.

R. Douglas Powell.

**STHENIC** (*σθένος*, strength).—This term is applied, first, to individuals when they are vigorous and strong; and, secondly, to inflammatory diseases, when they assume an active character, such as *sthenic pneumonia*, as distinguished from *asthenic*. *See* Disease, Classification of.

**STIFF-NECK.**—A popular name for muscular torticollis. *See* Rheumatism, Muscular.

**STILLICIDIUM** (*stilla*, a drop, and *cado*, I fall).—The falling of a fluid drop by drop. The term is used to express the flowing of the tears over the lower eyelid in obstructions of the lachrymal passages; also the dropping of the urine in strangury (*see* Eye and its Appendages, Diseases of; and Strangury). As a therapeutic method of application, stillicidium signifies the dropping of a fluid upon a part. *See* Cold, Therapeutics of.

**STIMULANTS** (*stimulo*, I stir up).—Definition.—A stimulant is anything which increases the natural function of a part, or which causes a slight degree of superficial irritation.

Enumeration.—Stimulants may be divided into *general*, *cardiac*, *vascular*, and *cerebral*, as Alcohol, Ether, Opium, and Ammonia; *spinal*, including Nux vomica, Strychnia, Phosphorus, Morphia, Ergot, and Belladonna; and *stomachic*, as Ginger, Capsicum, Mustard, and other so-called carminative substances.

Actions.—Taking the term stimulant in its

widest sense, we are bound to admit that it has very close ties of relationship with almost every other therapeutical group. Thus a drastic purgative is a stimulant to the intestinal mucous membrane; and cholagogues promote the secretion of the liver. So we have stimulating diuretics, diaphoretics, and emetics, and drugs which directly stimulate certain organs or glands, as when ergot evacuates the contents of the womb, or jaborandi causes a copious salivary flow. It is quite sufficient for our present purpose, however, merely to direct attention to these bearings of the subject, which will receive fuller notice in other articles, and the enumeration already given shows within what limits we must proceed.

**General Stimulants.**—The agents which are sometimes called 'general stimulants' act, in the first instance, on the nervous structures of the heart, improving the tone and vigour of the circulation; and, as a result of the increased quantity of blood sent to the brain, the intellectual functions seem to be temporarily augmented. Alcohol in small quantity undoubtedly makes the pulse fuller and firmer; gives rise to a pleasant glow and sensation of general warmth; and appears to lend rapidity and freedom to the cerebral operations. Opium, in small doses, has much the same effect. But pushed beyond this point, or given in larger quantity, both these drugs enter upon their sedative and narcotic phase; dulness succeeds the briskness of excited function; and a semi-paralysed condition of nervous energy ensues, ending in sleep. Diffusible stimulants, as they are called, such as ether, and ammonia, stimulate perhaps less actively in the first instance; but their effects pass more speedily away, and are not succeeded by any prolonged or well-marked period of subsequent depression.

**Vascular Stimulants.**—Cardiac and cerebral stimulants are included in what has just been said, but a special division of vascular stimulants is supplied by those drugs which seem to brace up and give tone to weakened vessels. It is thus, no doubt, that we may explain the influence of opium in lending a healthier action to indolent or spreading ulcerations; or to the faculty which quinine seems to possess in some degree of arresting localised suppuration.

**Spinal Stimulants.**—The best type of spinal stimulant is strychnia, which powerfully excites the reflex functions of the cord, and whose tetanising action is somewhat imitated, in the lower animals at least, by morphia and thebaia. Under this heading we may also include belladonna and carbonate of ammonia, which have a well-marked stimulating influence over the respiratory centre, situated in the medulla oblongata.

**Stomachic Stimulants.**—Stomachic stimulants run closely on a parallel with tonics, and probably act by gently irritating the mucous membrane, and supplying a sensation strongly resembling the natural physiological craving or desire for food, which constitutes hunger.

**Uses.**—Whatever views we may hold regarding the propriety of recommending stimulants to persons in full health, the urgent necessity for their administration in certain diseased conditions is one of the fundamental principles of medicine. True although it be that we may often treat acute illness very successfully without alcohol, it is no less an acknowledged fact that, under well-recognised conditions, we are bound to give it to our patients with no sparing hand. When the tongue is becoming dry and brown; when the pulse is weak, soft, rapid, and irregular; when the first sound of the heart is low and muffled; and when muttering delirium is setting in—then we know that the time for wine or spirit has arrived, and that under its judicious use the tongue will moisten, the pulse become slower and firmer, and the sufferer may sink into a refreshing sleep. Good whisky or brandy, or the effervescing wines, are best suited for these emergencies, and must be given at regular intervals and in carefully-measured doses, according as the progress of the disease and the condition of the patient seem to render their administration necessary. In convalescence also a little stimulant will promote the appetite and increase the general tone; and good port, Burgundy, or Madeira, or some of the lighter beers, will act well, in virtue of their tonic properties.

Although it seems to be now generally acknowledged that stimulants are not required by the strong and robust, many dwellers in large towns, frequently pursuing unhealthy occupations, subject to much mental strain and worry, and suffering perhaps from depression and want of appetite, derive great benefit from a little sound wine or beer. Under the influence of the stimulant, the secretion of gastric juice is augmented, and more food can be taken and digested, the only caution being that the dose shall be strictly moderate in quantity, and invariably taken with the meals. *See* Alcohol.

The diffusible stimulants also have their place in the treatment of disease, when we wish to produce a slighter and more transient effect; and carbonate of ammonia is of especial service in the advanced stages of bronchitis, from its stimulating influence on the respiratory centre.

Nux vomica and strychnia are occasionally used with benefit in spinal disorders when the more acute symptoms have passed away, and when loss of function from sheer debility seems to be the principal obstacle to the recovery of the patient.

The stomachic stimulants find their application in cases where the appetite flags, and when the desire for food requires to be promoted by artificial means. Dwellers in tropical climates make greater use than ourselves of cayenne and other fiery additions to the dietary; and it seems probable that by thus attracting an increased flow of blood to the stomach, more gastric juice may be secreted, and the individual be justified in consuming the greater quantity of food which the increased development of appetite seems to render necessary. R. Farquharson.

## STING: STINGING PLANTS AND ANIMALS.

—Synon.: Fr. *Aiguillon*; Ger. *Stachel.*

Definition.—A sting is an abnormal sensation, partly painful, and partly itching in character, usually caused by the introduction beneath the skin of some poison of an animal or

vegetable origin. Either increment of the sensation may predominate, and the stung surface may be simply painful and tender, or the itching may be intense, and lead to considerable scratching for its relief.

In the widest acceptation of the word, the effect produced by the application to the skin of such substances as mustard, cantharides, strong carbolic acid, and the like, may be denominated as stinging; but here it is proposed to consider only the wounds inflicted by stinging plants and animals. The subject of venomous animals is separately discussed. *See* Venomous Animals.

Ætiology.—The severity of the sensation and of the local constitutional effects of stinging, depends, not only on the quality and quantity of the irritant, but also on individual susceptibility; in some persons the effect may be extremely mild and transient, in others severe symptoms may ensue.

In respect to the peculiar susceptibility of the person attacked, the greatest difference is observable amongst individuals, and even in the same person at different times. In many of the recorded fatal cases, the victim had been previously stung and had suffered severely. There seems, however, reason to believe that the system becomes more resistant to the effects after repeated stingings, as is seen to be the case among bee-keepers, and those continually exposed to mosquitoes. Some variations in the violence of the poison, whether of animal or plant, occurs with the season of the year.

**Stinging Plants.**—These are almost entirely limited to the order *Urticaceæ*, of which the following species are the most important: *U. urens*, *U. dioica* (British), *U. crenulata*, *U. stimulans* (Indian), *U. ferox* (New Zealand), *U. gigas* (New South Wales), (which forms lofty trees), and *U. urentissima* (Java). A few species of the order Malpighiaciæ also possess stinging properties.

In the nettles the urticating organs consist of unicellular hairs tapering towards the free end, which terminates in a bent knob, and swelling out at the attached extremity, where it is received into a cup-shaped depression of a cellular pedicel. The acrid fluid, the nature of which has not been determined, but is supposed to be an acid similar to malic or acetic acid, is regarded as being secreted by the pedicel and stored in the stinging hair, from which it escapes into the integument when the brittle knobbed tip is broken off by contact. The hairs in the Malpighiads are peltate and not tapering.

**Stinging Animals.** — Urticating organs, known as *trichocysts*, *cnidæ*, or *thread-cells*, similar in function only to the stinging cells of nettles, are found in many animals, such as the Infusoria, some Annelida, and several Nudibranchiate mollusca. They are, however, best developed and most characteristic in the Cœlenterata, of which the jelly-fishes or sea-nettles are the best known. These organs consist of cells, containing an acrid fluid, and prolonged into a long filament which presents numerous modifications of barbs and serrations. The filament is usually spirally coiled within the cell, from which it is everted on contact, conveying the fluid into the surface that it penetrates. Great variety exists in the form, size, and disposition of these organs; in many of the Actinozoa or sea-anemones they are arranged in rope-like clusters, enclosed in fine tubes, within the body-cavity.

The power of stinging is possessed very generally by members of the articulate sub-kingdom, such as spiders and scorpions among the Arachnida; bees, wasps, mosquitoes, and ants among the Insecta. The bite of the flea or bug produces itching rather than a sting. In all cases of true stinging an irritant fluid, thought to be of the nature of formic acid, is introduced beneath the skin by some penetrating organ, which may be connected with the trunk or with the terminal segment of the abdomen.

Effects.—The introduction of the poison of a stinging vegetable or animal is followed, either immediately or within a very short time, by erythema of the affected part, the surface being red and swollen. If a mucous membrane, as of the mouth, have been the seat of the wound, the swelling is intense, the tongue cannot be protruded, and swallowing becomes difficult or even impossible. Nor are the results limited to the locality of the sting, the erythema often spreading to a considerable extent, from the hands or face, which are obviously the most frequent starting-point, to the arms, neck, and trunk. Associated with the local manifestations, general symptoms, often of a most severe and even fatal character, have been known to occur. Well-authenticated cases of death from the stings of bees, wasps, scorpions, and even some species of tropical nettles, have been placed on record.

In the majority of such cases the poison has brought on a state of syncope; severe prostration, pallor, and pulselessness being the most general symptoms; and death has been known to occur within a quarter of an hour, or from that to a few hours. When the case does not prove fatal, recovery is generally rapid and the patient is quite well in a day or two; but this is not always so, and the effects of some nettles (for example, Urtica urentissima, the Devil's leaf of Java) are said to last for years.

Treatment.—(*a*) *Local.*—Innumerable applications have been suggested as specifics in cases of stinging. Among those most generally resorted to are alkalies, such as liquor ammoniæ, or a solution of bicarbonate of soda or of potash. If applied to the stung surface directly they are undoubtedly efficacious. Carbolised oil (1 in 20) has been successfully employed for the stings of bees and wasps. Lint soaked in chloroform, and laid over the seat of the bite, is recommended; and ipecacuanha applied externally is said to be most beneficial. The writer has found nothing so successful for the relief of mosquito-bites as the oil of pennyroyal, which has the further effect of most completely keeping away these insects.

(*b*) *General.*—When constitutional symptoms are produced, stimulation with brandy, ammonia, and ether is an absolute necessity, and one or other of these should be administered without stint, as life undoubtedly depends on counteracting the cardiac depression.

W. H. Allchin.

**STITCH.**—A sharp catching pain in the side, generally associated with pleurisy, pleurodynia, or intercostal neuralgia. *See* Pleura, Diseases of.

**STOMACH. Diseases of.**—Synon.: Fr. *Maladies de l'Estomac*; Ger. *Krankheiten des Magens.*—The stomach is a widely expanded gland, exceeding in activity of function any other secreting structure in the body. When its surface is examined with a microscope of low power, it presents, in every part, small superficial pits or depressions, which are surrounded by slightly elevated ridges. Into these pits open a number of the tubes which form the secreting structure of the organ. The whole of the surface of the mucous membrane, as well as the depressions just mentioned, is covered by a layer of conical epithelium, whose office it is to secrete mucus, as well as to shield the sensitive textures beneath it. When a vertical section of the walls of the stomach is made, the whole of the glandular portion is seen to be composed of tubes, placed perpendicularly to the surface. In the infant the tubes are arranged in groups, which are separated from those near them by a sparing amount of fibrous tissue, along with blood-vessels and nerves; but in the adult this method of arrangement is much less clearly seen. The tubes vary in form in different parts. As a rule they are single, and placed side by side; but in the pyloric region they are wider, and occasionally give off cæcal prolongations towards their lower ends. The writer has sometimes suspected that these apparent projections from the tubes were the result of the sections not being carried quite perpendicularly through the membrane. Each tube is, on the average, about $\frac{1}{24}$ of an inch in length, by $\frac{1}{400}$ to $\frac{1}{300}$ of an inch in breadth; but there is considerable variety in this respect in the different parts of the stomach. In the cardiac portion they are generally shorter, and in the pyloric wider, than in the middle region. Each tube is formed externally of a transparent, structureless membrane, named the basement membrane. The upper portion of its length is lined for a variable distance from the pit into which it opens by conical epithelium, whilst the remaining part is filled with the true gastric cells. The gastric cells are round or oval in shape, and about $\frac{1}{1200}$ part of an inch in diameter. They present a prominent central nucleus, along with fatty and albuminous granules. These cells appear to secrete and contain the pepsin, on which the digestive power of the gastric secretion depends. In the pyloric region we meet with numerous tubes which are entirely filled with conical epithelium, and others in which only their lower ends present true gastric cells. Some authors have asserted that the tubes in the pyloric region are entirely devoid of cells containing pepsin. Although such appears to be the case in some of the lower animals, it is not true as regards the human subject. The tubes are retained in their position by fine fibres, that pass up between them from the sub-mucous tissue to the surface. The arteries perforate the muscular structure, and send up branches between the tubes. In this position they give off fine branches, which communicate freely with the neighbouring vessels. Arrived at the surface they again increase in size, and form a dense network of capillaries which occupies the ridges of the pits into which the tubes open. From this network the veins pass downwards between the tubes, and eventually pour their contents into the larger venous trunks situated in the submucous tissue. The lymphatics are arranged in two sets: one situated immediately beneath the peritoneum; and the other between the mucous and muscular layers. They communicate with glands chiefly situated near the lesser curvature. The nerves are derived from the sympathetic and pneumogastric nerves. In the submucous tissue their branches form a plexus, and are connected with numerous ganglia.

Such being an outline of the structure of the stomach, its diseases will now be considered, and in alphabetical order. Several important subjects, intimately associated with disorder or disease of the stomach, are discussed separately under their own headings. *See* Digestion, Disorders of; Digestive Organs, Diseases of; Eructation; Flatulence; Pylorus, Diseases of; and Pyrosis.

1. **Stomach, Abscess in the Walls of.**—This is a rare disease, and appears to occur under two distinct forms. In one the walls of the stomach are the seat of cancer or of fibroid thickening. In cancer inflammation occasionally takes place in the newly-formed structure, and the pus resulting from it bursts through a number of openings in the mucous membrane. A similar condition occasionally occurs in fibroid thickening. Some have supposed that the thickening in such cases is the result of the inflammation that produced the pus; but more probably the suppuration is an acute change supervening on a chronic morbid condition.

Still more rarely, general suppuration occurs in the submucous tissue of the stomach. In most of the cases of the kind which have been recorded the patients have died of pyæmia, and in all probability the suppuration is secondary. In the cases of localised suppuration that have come under the notice of the writer there were no distinctive signs likely to attract the attention of the practitioner. Dr. Brinton describes the symptoms of this form of gastritis as 'violent pain, and tenderness in the region of the stomach, attended by severe and frequent vomiting, and by high febrile reaction. The pain and vomiting increase in severity, and the tenderness becomes so excessive as to suggest peritonitis, the more so that it is often accompanied by some tympanites, which however, like itself, sometimes differs from that of general peritonitis in being limited to the epigastrium. By-and-by jaundice may come on. In any case the febrile excitement rapidly merges into prostration, which is associated with delirium, and ends in death in from forty-eight hours to a few days from the commencement of the attack.'

Treatment.—The treatment of such cases, where they can be recognised during life, must be the same as that required for the general affection of which they form a part.

2. **Stomach, Albuminoid Disease of.**—Albuminoid, waxy, or lardaceous disease not unfrequently affects the mucous membrane of the

stomach and bowels. It is always associated with a similar condition of the liver, spleen, or kidneys, the writer not having met with any case where the digestive tract was alone the seat of this morbid change. The mucous membrane presents a pale and bloodless appearance, and affords, with iodine, the well-known brownish-red reaction. In some cases the surface of the stomach is much congested, tough, and thickened from the co-existence of chronic catarrhal gastritis. Dr. Wilson Fox states that 'in some instances all traces of the epithelial cells are destroyed, and the contents of the tubes are converted into the refracting, homogeneous, irregular masses, into which the histological elements of the tissues are always changed in cases of this disease.' From its constant association with a similar condition of important organs, it is difficult to assign to this affection of the mucous membrane any characteristic symptoms. In all probability, the diarrhœa that accompanies lardaceous disease originates from a similar affection of the intestinal tract; and the vomiting that more rarely presents itself may be a consequence of a morbid condition of the stomach.

3. **Stomach, Atony of.**—There are numerous cases of indigestion in which the most careful inquiry fails to ascertain any structural change in the stomach. These are usually classed under the head of 'atonic dyspepsia,' and the symptoms seem to arise either from an imperfect secretion of gastric juice, or from the muscular movements of the organ being so enfeebled that the food is allowed to remain an undue length of time in the first part of the digestive canal.

Ætiology.—A feeble state of the digestion may occur at all ages, but more especially in the decline of life. The stomach, like all other glands, loses its power of secretion as age advances, and, consequently, we find dyspepsia a common complaint amongst the old. Females are more liable to it than males, who are more apt to suffer from inflammatory changes in the gastric mucous membrane. It cannot be too much impressed upon the mind of the practitioner, that an enfeebled condition of the stomach is a constant result of gastritis, and, in like manner, a diminution in the power of the digestion predisposes to attacks of inflammation. Atonic dyspepsia may be an hereditary disease, and when this is the case the symptoms usually manifest themselves at an early period of life. So long as the growth of the body continues, little trouble is experienced in such cases; but from twenty to thirty, when the necessity for great activity of the nutritive powers ceases, the patient feels himself incapable of digesting his food as easily as before. It is not, however, necessary that the child should experience the same form of gastric disorder as his parent, for one may suffer from mere feebleness of digestion, whilst the other may have been liable to the inflammatory form of dyspepsia. It is, perhaps, scarcely necessary to observe that there is no complaint so liable to be excited by errors in diet. A stomach, which, although it performs its functions feebly, may be able to digest as much food as is requisite for the maintenance of health, may be incapable of disposing of enough to satisfy the desires of a person who seeks his pleasure in the gratification of his palate. Consequently, one of the most common causes of atonic dyspepsia, more especially amongst the richer classes of society, is to be found in the undue frequency of meals. Every practitioner is consulted by persons complaining of dyspepsia produced by food, in some shape or another, being taken every two or three hours, under the supposition that they are suffering from debility. In reality, the feeling of exhaustion from which they suffer arises from the stomach never being allowed a sufficient period of repose. It is called into renewed activity by the introduction of fresh food before the last meal has been passed into the duodenum. Imperfect digestion is the necessary consequence, and only a small portion of what is eaten is dissolved and reaches the blood. On the other hand, atonic dyspepsia constantly arises amongst the poor from an imperfect supply of food, or from the food not being of a nutritious nature. The out-patient rooms of our public institutions are daily frequented by females who are existing on tea and a scanty supply of bread, and who could be readily cured by a more generous diet. An immoderate use of alcoholic liquors seems chiefly to favour the production of inflammatory gastritis; but the writer has constantly seen those who had habituated themselves to such indulgence become the victims of feeble digestion as soon as they have abandoned the use of stimulants. It is, however, much better that persons who are unable to take stimulants in moderation should suffer from dyspepsia than subject themselves to the innumerable other evils arising from drunkenness. Imperfect mastication is a common cause of this complaint. The writer has found that only 19 per cent. of those who were not dyspeptics confessed to the habit of eating very quickly, whilst amongst the sufferers from gastric disorders 51 per cent. were in the habit of imperfectly masticating their food. Persons who live chiefly on liquids, such as tea and soup, are more liable than others to feeble digestion. In all probability the mucous membrane becomes relaxed, and the gastric juice is too much diluted to dissolve the food with the requisite rapidity. Insufficient exercise is another very common cause of the complaint, and those who lead indolent and luxurious lives pay the penalty in the shape of dyspepsia. Constipation is another common cause of this form of indigestion, and it is partly by producing this symptom that sedentary occupations exercise such a prejudicial influence. As the gastric fluid is secreted from the blood, it is evident that a normal amount and quality of the latter must be necessary for the perfect performance of the digestive process. Consequently, we find that the digestion becomes feeble in all cases of anæmia, however this condition may have been produced. Numbers of cases are constantly presenting themselves in the out-patient department of every hospital in which the symptoms of atonic dyspepsia are maintained by long-standing leucorrhœa or other discharges. The nervous system controls, not only the secretion of the gastric fluid, but also the muscular action of the organ. Any deviation, therefore, from its

normal state is apt to be attended with an alteration in the secretion and motions of the stomach. In the more acute disorders of the brain we often have an excess of acid secreted; but whenever the nervous system is enfeebled, the functions of the digestive canal are weakened in a corresponding degree.

Symptoms.—The invasion of atonic dyspepsia is always gradual, and in a large proportion of the cases the symptoms replace those of acute or chronic gastritis. There is seldom any severe pain, but the patient often complains of a feeling of fulness and distension after meals, which begins shortly after eating, and lasts for an hour or two. In other instances there is a sensation of constriction, produced by flatulence, which affects the lower part of the chest, and is relieved by eructation. Occasionally, the pain radiates to the shoulders, or passes down the left arm and hand, so severely as to simulate angina pectoris. It is distinguished from that complaint by its coming on shortly after food, and not after exertion. In other cases the constriction is accompanied by dyspnœa, arising, no doubt, from the movements of the diaphragm being impeded through its being pushed upwards by the distended stomach. In men of advanced age who are inclined to obesity there may be considerable embarrassment of the pulmonary and cardiac functions from this cause, especially where any unusual exertion is undertaken after a meal. It is, perhaps, unnecessary to say that in hysterical persons, and in those whose nervous systems have been unduly excited by alcohol, there is often a shrinking from the slightest touch upon the skin. In these conditions the tenderness is general; it is not increased by deep pressure, and is often most loudly complained of when the hand is applied to a part distant from the stomach. Vomiting rarely presents itself, excepting as the result of some temporary error in diet, or as an accompaniment of hysteria or phthisis. Eructations are generally complained of; but, instead of the acidity that accompanies catarrhal inflammation of the stomach, only gas or small portions of undigested food are returned. The appetite is generally deficient; in some cases there is a craving for various indigestible substances, but this is not so common as in the inflammatory affections of the stomach. Sometimes there is an aversion to all food. The tongue is usually broad, flabby, indented by the teeth, but not red, pointed, or injected, as in gastritis. Thirst as a rule is absent. The large intestine corresponds in the feebleness of its functional power. The bowels are consequently constipated, the stools disordered, and, in many cases, they contain large portions of undigested food. The most common appearance is of pieces of fibre-like tissue that have escaped the action of the stomach, often mistaken by patients for worms. The urine is usually pale and of low specific gravity. If it deposits lithates, the sediment is pale in colour; more generally oxalates or phosphates make their appearance. A long continuance of imperfect digestion produces loss of flesh and strength, but this is never to the extent that occurs in the organic affections of the stomach. The pulse is slow and feeble. The heart is especially apt to be affected with palpitation. Often the patient complains of a sudden tumbling sensation, as though the heart had turned over; at other times the palpitation comes on after exertion, and relief is obtained by stooping, or some other change of posture. Some are chiefly tormented at nights. They are awakened at two or three o'clock in the morning with violent and irregular palpitation. Such cases occur most frequently in the old, and often indicate a fatty condition of the organ. The skin is cold and clammy; and irregularities in the circulation, producing coldness of the hands or feet, are constant sources of complaint.

The nervous symptoms constitute the most distressing manifestations of the disease, more especially when the affection itself arises from an exhausted condition of the nervous system. The patient awakes at two or three in the morning, and is unable to sleep for many hours, when perhaps he falls into a troubled and unrefreshing slumber. There is often great irritability of temper, gloom obscures the mind, or the patient is incapable of concentrating his mental powers, or he becomes feeble and irresolute in character.

Diagnosis.—Atonic dyspepsia is not likely to be confounded with the painful affections of the stomach—namely, ulcer and cancer. It is, however, a point of great practical importance to distinguish it from an inflammatory affection of the mucous membrane. This is the more difficult because these conditions so often replace each other in the progress of a case of chronic dyspepsia. The chief differences are as follows. In atonic dyspepsia there is no epigastric tenderness, which is usually present in gastritis. There is no pain excepting what may easily be referred to flatulent distension; and acidity and heartburn are much more rare in the former. Vomiting, again, is unusual in atonic dyspepsia; common in gastritis. The tongue is broad, flabby, and tolerably clean, and forms a striking contrast to its injected tip and edges, and thick coating in the latter affection. The urine is pale, depositing oxalates or phosphates, in a feeble state of the stomach; high-coloured, and loaded with lithates, when the organ is inflamed.

Treatment.—The first and most important point is to remove, as far as possible, all the causes of the disease. It is evident if a patient is eating too frequently, or masticates his food imperfectly, or leads an indolent and luxurious life, all drugs must be unavailing to remove his disease, so long as he maintains it by an erroneous system of living. Again, the food should be of such a nature as will require the least possible exertion on the part of the stomach. Thus, lightly-cooked mutton, chicken, or game is more easily digested than beef, pork, or lamb. Roast meat is more digestible than boiled. Soups and broths should be avoided, as well as any large quantity of hot tea or coffee. In bad cases vegetables had better be omitted from the dietary for a time; but as soon as the patient improves they should be again employed. Great mischief is often done by forbidding for a length of time all vegetable food; for, although the flatulence and other symptoms may be thereby relieved, the general health soon suffers. In many cases it will be found useful, where we are forced

to forbid vegetables, to order one or two tablespoonfuls of lemon juice daily. This may be either taken diluted with water, or squeezed from the lemon over the meat. When there is much tendency to acidity, light puddings and farinaceous food must be sparingly used, but otherwise they generally agree well. Pastry and new-baked bread should be avoided in all cases.

When a person of middle age and inclined to obesity is troubled with feeble digestion it is better that he should avoid potatoes, spirituous liquors, sweets and fatty substances; and that he should use dry toast instead of bread, and a simple but varied diet. A dinner-pill of rhubarb, ipecacuanha, and ginger may be given to aid digestion, accompanied by a nervine tonic, such as strychnia or tincture of nux vomica, combined with nitro-hydrochloric acid.

Innumerable remedies are recommended for this form of indigestion, but in order that they should be usefully employed, it is necessary to ascertain the cause from which the imperfect secretion of gastric juice has arisen. In a large proportion of the cases the feeble condition of the mucous membrane has resulted from previous inflammation. There is a second class where, although the gland-structure is normal, the blood is deficient in quantity, or is abnormal in quality. In a third the defect originates with an exhausted condition of the nervous centres. Each of these states requires a separate medicinal treatment, and, although one often merges into, or is associated with, another condition, yet the features of one or other appear more prominently in each case that comes under our notice.

Where the feeble digestion has arisen from a relaxed state of the mucous membrane produced by previous inflammation, the tonic should be of an astringent character. It is in such cases that the nitric, nitrohydrochloric, or phosphoric acid, either alone or in combination with bitter infusion, is required. Acids are best given when the stomach is empty, so that they may directly affect the vascular system of the organ. If metallic preparations are preferred, the perchloride of iron may be used. Notwithstanding the adverse opinions of many authors, the writer has often found pepsin very valuable in these cases. The pepsina porci is the best preparation, and it may be given along with capsicum or ipecacuanha before, not after, meals. One reason why pepsin so often proves inefficacious is that it is not administered in sufficient doses. In cases of feeble digestion in young children or aged persons, much benefit will sometimes result from the addition of pepsin, in larger quantities than usually prescribed, to milk, warmed and left to stand a short time before being taken; or peptonised food may be ordered in some cases. *See* Peptonised Food.

Where the dyspepsia arises from anæmia, recourse must be had to iron. If it is connected with excessive menstrual discharge or leucorrhœa, the writer has often found the phosphate of iron and manganese a useful preparation. In other cases it may be combined with quinine. The saccharo-carbonate and the ammonio-citrate are very valuable and unirritating salts. It is a good plan in these cases to alternate the steel with other tonics, and as liberal a diet should be given as can be easily digested.

Where the nervous system is chiefly in fault preparations of nux vomica and phosphorus, or those of zinc and arsenic, are chiefly of use. Zinc may be given as a valerianate along with quinine, or as a superphosphate in combination with iron. It is in this class of cases that preparations of silver, such as the nitrate and oxide, are chiefly valuable.

The colon is usually as atonic as the stomach, and therefore the bowels require attention in almost every case that comes beneath our notice. All severe purgatives should be avoided; for nothing so increases the feebleness of the digestion as the indiscriminate employment of this class of drugs. Salines, such as the sulphate of magnesia and the various mineral waters, must be especially prohibited. The most useful aperients are rhubarb pill, combined with nux vomica or belladonna. When there is no affection of the rectum, the extract of aloes answers well; or if this part is irritable some mild aperient, such as senna electuary, may be employed. Where a slight amount of acidity is present the compound rhubarb powder of the pharmacopœia, or an occasional dose of soda and rhubarb, is most suitable.

4. **Stomach, Atrophy of.**—Analogy would lead us to expect that the structure of the stomach would be liable to atrophy, since this change is so often met with in the kidney, liver, and other glandular organs; and this expectation would be strengthened if we considered the great functional activity of the gastric mucous membrane, and its especial liability to inflammatory changes. We find that atrophy of portions of the gland-structure of the stomach is exceedingly common, although sufficient usually remains intact to enable the organ to perform its functions. From his own investigations the writer is led to believe that a certain amount of anatomical change occurs in every person after he has reached the middle period of life, when the necessity for a superabundant supply of nutriment has ceased. It takes place first in the pyloric region, and tends gradually to extend as age advances. Caution is required in the investigation of such changes in the case of the stomach, lest the effects of *post-mortem* digestion should be mistaken for those of disease. In both the mucous membrane is attenuated, and the structure destroyed; but in the former it is soft, and can be readily detached by the slightest pressure of the finger; in the latter it is firm, adherent, and usually pale and anæmic. Microscopically, in *post-mortem* solution, the surface is uneven; in atrophy it is smooth, and the openings of the tubes are sharp, defined, and often enlarged. On a section being made, in the former the tissue is seen to be reduced to a mere mass of cells and fat; in the latter the lower ends of the tubes are often enlarged and loaded with cells.

Anatomical Characters.— In atrophy of the stomach the mucous membrane usually escapes *post-mortem* digestion; it is thin, smooth, and firmly adherent to the subjacent coats. Micro-

scopically, in the earlier stage of the disease the solitary glands are enlarged, and filled with cells and nuclei. The gastric tubes, and sometimes the subjacent muscular fibres, are displaced by these bodies, which are scattered everywhere through the membrane. The tubes adhere firmly to each other, but they still contain normal cells. Later in the disease the solitary glands appear empty in their centres, but surrounded by thick layers of nuclei; the tubes can no longer be traced throughout their whole extent, but can only be recognised as bulbs filled with fatty cells, or as lines of cells, whilst the whole tissue is obscured by fatty and granular matters. In the last stage the solitary glands have disappeared, and the tubes are replaced by fibres. In some cases observed by the writer, although the mucous membrane was very thin, it was so fatty that 33 per cent. was removed when digested in ether. These anatomical changes seem to produce a concomitant decrease in functional power. *Post-mortem* digestion seldom occurs, even in the summer, and in one case in which the writer performed artificial digestion with the whole mucous membrane, only six-tenths of a grain of albumen was dissolved, and in two others the albumen was only softened. When a similar experiment was performed with the stomachs of persons who had died of other diseases, four grains of albumen was the average amount dissolved, the remainder being softened and translucent.

Symptoms and Causes.—Atrophy of the stomach presents itself clinically in three different forms:—

1. We find it combined with inflammation of some of the other coats of the organ, and proving fatal by the exhaustion of the patient. A man, thirty-nine years of age, was admitted into the London Hospital, under the care of the writer, in 1873. Some enlarged lymphatic glands of the axilla had existed for twelve months, and for six months he had suffered pain immediately after eating, attended by vomiting shortly after meals. When admitted, the vomiting occurred daily, and he brought up an intensely acid fluid. This gradually subsided, but he lost flesh and strength, and died from exhaustion. On *post-mortem* examination, all the organs proved to be healthy, excepting the stomach, the coats of which for some distance from the pylorus were greatly thickened, whilst the mucous membrane was extensively atrophied throughout the whole organ. Cases like this are mentioned by most authors on diseases of the stomach, and are usually quoted to show how slight may be the anatomical changes sufficient to produce death. But when the microscope is brought to bear upon the point, the atrophy of the glandular structure is found to be very extensive, so much so that if an equal amount of morbid change were to present itself in a closely-packed glandular organ, as, for example, in the kidney or liver, it would be at once recognised and its importance acknowledged.

2. The second class includes a large number of the cases known as 'idiopathic anæmia,' and, in all probability, the morbid alterations result, not from inflammation, but from degeneration. The writer has met with some marked cases corroborating this statement. Dr. Handfield Jones quotes a case of 'extreme anæmia,' in a man aged sixty-two, in which there was general atrophy of the stomach (*Morbid Conditions of the Stomach*, p. 108). Sappey mentions the case of a young man, aged thirty-two, who had died in a state of marasmus, in whom almost all the pepsiniferous glands had been destroyed, excepting those in the pyloric region. It is evident from these cases that a considerable proportion of those suffering from idiopathic anæmia are really the subjects of atrophy of the stomach. There is not much emaciation, for the pancreas, liver, and absorbing apparatus of the intestines are capable of digesting and taking up the fat. But the heart, like the other tissues, becomes loaded with fatty matter; and it has therefore often happened that the general feebleness and evident want of blood have been attributed to this state of the centre of the circulation, and the patient has been said to have died of 'fatty heart.'

3. There is a third class of cases in which atrophy of the stomach occurs, without any very especial symptoms during life pointing to the organ thus seriously diseased. The writer carefully examined the structure in fifty-seven persons who had died of cancer affecting various organs of the body. Fifteen of these were females, who suffered from cancer of the breast, and of these 75 per cent. presented well-marked atrophy of the glandular structure of the stomach. In twenty-four there was disease of the uterus, and gastric atrophy was present only in three of these; whilst no case occurred amongst persons affected with malignant disease of the glands, bones, or skin. It is evident, therefore, that the atrophy of the stomach only accompanies certain forms of cancer. In those cases of cancer of the breast where the microscope disclosed atrophy, the mucous membrane was much attenuated and its weight diminished; in one case it only weighed 360 grains, the average weight in females dying from other diseases being 720 grains. The amount of pepsin contained in the gland-structure was, in every case in which it was tested, remarkably deficient. The diminution in the weight of the mucous membrane in these cases was not the result of a general wasting of the body, for in cancer of the uterus the average weight was 660 grains. The co-existence of this serious disease of the stomach with cancer of the breast, supplies us with an explanation of the fact, that many cases die some time after an operation has been performed, in whom there has been but a trifling reappearance of the malignant growth, and no great amount of discharge or of bleeding, to account for the gradual loss of flesh and strength. The writer has seen different cases of this kind, and has remarked that the cancerous tumour is usually slow in its growth, liable to contract, and that eventually nodules form in different parts of the skin. The dyspeptic symptoms are limited to failure in appetite, often a disgust for animal food, and flatulence, accompanied by a gradual loss of flesh, strength, and colour.

Diagnosis.—Atrophy of the stomach can only be diagnosed by the exclusion of all other dis-

eases that tend to produce anæmia. Hæmorrhage and other discharges must, of course, be strictly inquired for, and it must not be forgotten that bleedings may be going on in the digestive canal without having attracted the observation of the patient. It must be also remembered that anæmia very often occurs from merely temporary failure of the digestive powers, at the commencement and termination of the catamenia. When we meet with a case of progressive anæmia in a person of middle life, we should also examine the blood in order to exclude leukæmia. In this disease, as is well known, the white blood-cells are greatly increased in number, whilst the writer has found in atrophy of the stomach a diminution in both kinds of cells. Where we find the above diseases absent, no discolouration of the skin, and no signs of malignant disease, we may fairly suspect the presence of gastric atrophy. This suspicion would be strengthened if the patient were affected with cancer of the breast, or a hard malignant tumour of any other organ.

Treatment.—The most important point in treatment is the regulation of the diet. As there is usually a great distaste for animal food, the ingenuity of the practitioner is often severely taxed to discover some form of food likely to furnish albumen to the system which the patient can be prevailed upon to take. The articles of diet that usually agree best are mutton, fowls, game, soles, whiting, haddock, and oysters. It is often necessary to order that the meat should be beaten up, or minced, so that it may be swallowed quickly. Milk and eggs, where they agree, are invaluable, and in the later stages soups and animal broths may be substituted for solid food. The writer has often recommended specially prepared beef-tea, which may be composed of extract of beef that has been digested by means of pepsin. Some patients object greatly to the taste of it, and it is a useful plan to give it mixed with ordinary beef-tea or chicken-broth, or with a proportion of invalid turtle-soup. In some cases gluten bread and gluten chocolate answer well. Other articles of diet, composed of starch and sugar, are usually more readily taken, and more easily digested.

As regards medicines, steel in all shapes is beneficial. It may be combined with strychnia, quinine, or other bitters, according to the circumstances of the case. Arsenic may be used with advantage, but it will be found a good plan to alternate it with other tonics. Pepsin is often prescribed, but it does not produce much benefit. Acids are often valuable, the most useful being the hydrochloric and phosphoric. They are best given, it is said, shortly after a meal.

Change of air, travelling, and freedom from the cares of business, are generally of more use in retarding the progress of the disease than any drugs we can prescribe.

**5. Stomach, Cancer of.**—Malignant disease of this organ is much less common than simple ulceration, but nevertheless the stomach is more frequently the seat of cancer than any other organ in the body, with the exception of the uterus. It is almost always primary, unless it arise from an extension of disease from some neighbouring organ. Secondary malignant affections of the stomach are exceedingly rare.

Ætiology.—The tendency to gastric cancer increases with the age of the individual. Dr. Brinton collected 600 cases, and found the average age at death to be fifty; the greatest liability being between sixty and seventy. It is very rare below thirty, and up to forty the liability is scarcely equal to one-fifth of the whole. Males seem to be twice as liable to gastric cancer as females, and although the accuracy of this statement has been called in question, the writer's own experience tends to confirm it. In a large number of cases there is a history of hereditary transmission, and so completely is this established, that the mere fact of more than one member of a family having suffered from cancer, would lead us to diagnose its presence in a doubtful case. Neither anxiety, poverty, nor intemperance seems to influence the development of the disease.

Anatomical Characters.—All the varieties of cancer of the stomach are here met with, but scirrhus is by far the most common. According to the researches of Dr. Brinton, it constitutes 72 per cent. of all the cases. Next in order of frequency he places the medullary form, which amounts to 18 per cent. Colloid cancer is much more infrequent, excepting when in combination with scirrhus. These different forms are, however, very often combined with each other. Thus we meet with scirrhus combined with medullary or colloid cancer. Microscopically the new growths present the ordinary appearances characteristic of the forms of the disease to which they belong. Cancer seems generally to begin in the submucous tissue, and spreads from thence to the other coats. The muscular structures vary in appearance in different cases. In some the normal tissue has been completely destroyed, and what appears to the naked eye as muscle proves to be, under the microscope, a mass of cancer cells and fibres. In other cases we find, even at some distance from the disease, the muscular bundles much increased in thickness, and the contractile fibre-cells greatly enlarged, with very prominent nuclei. Again, the pressure of the new growth puts a stop to nutrition, so that the muscular bundles seem to be reduced to a mere mass of fibrous threads. Of equal interest are the changes produced in the mucous membrane. Over the tumour the glandular tissue is generally destroyed, and nothing but cells and fibres represent the original texture. But in every case examined by the writer extensive disorganisation of the glandular structures has been found at a distance from the original disease. This is most marked in scirrhus, where we meet with the intertubular spaces filled with fibres, the tubes being atrophied, and often reduced to mere bulbs filled with fatty cells. Where the softer varieties of cancer form the main portion of the disease, the tubes are everywhere apparent, but are unusually loaded with cells, whilst between and below them nucleated cells are everywhere profusely scattered. This destruction of the glandular structure in cancer of the stomach is in marked contrast to what we find in cases of simple ulcer, for in

this the normal condition of the tubes can be readily seen at a very short distance from the edge of the sore. Cancer tends in the majority of cases to attack the orifices of the stomach, and here again is another point of difference between it and simple ulcer. Its most frequent seat is at the pylorus; according to Dr. Brinton 60 per cent. of all the cases being located in this region. In 13 per cent. it affected the cardiac orifice, the fundus being scarcely ever primarily attacked. It always has a tendency to spread in a transverse direction, so that an annular stricture is a common result. When it affects the pylorus, it scarcely ever implicates the duodenum; and, on the other hand, it seldom appears at the cardiac orifice without spreading to the lower end of the œsophagus.

Symptoms.—The symptoms of gastric cancer usually show themselves very insidiously. The patient complains of slight disturbance of digestion, acidity, flatulence, or want of appetite. It has been stated that in the majority of cases there has been no previous liability to dyspepsia. No certain rule can be laid down respecting this point. In many of the cases observed by the writer, dyspepsia has been present for years, whilst in others there have been no symptoms of gastric derangement, and the first signs of the cancer have occurred whilst the patient seemed in perfect health. In some the fatal illness has been ushered in by hæmatemesis; but this is uncommon. Pain is one of the most prominent symptoms. At first it is only slight, and is often described as a dull, gnawing sensation, but, as the complaint progresses, it assumes a more neuralgic character. Generally, it is referred to the epigastrium; in other instances to the back, or to the hypochondrium. It is ordinarily increased during digestion, but, unlike the pain of ulcer, it is often equally severe when the stomach is free from food. The pain of cancer has been said by some authors to be occasionally of a colicky character. This, probably, arises from a co-existing atony of the colon, for the writer has seen cases where this kind of pain was quite relieved when proper attention was directed to the large intestine. There is generally tenderness on pressure over the seat of the cancer, but it is not so localised, nor so severe, as in simple ulcer. Unless the pylorus is obstructed, there is rarely much complaint of acidity or flatulence. This arises from the fact that the absence of appetite prevents the patient from indulging in any large amount of food. When the growth affects the pylorus, the same symptoms are produced as in obstruction of this opening from any other cause (*see* Pylorus, Diseases of). Vomiting is a very general symptom, having occurred, according to Dr. Brinton, in 87 per cent. of his cases. It varies greatly, according to the part of the organ affected. In disease of the cardiac orifice it is almost always present, and arises partly from the co-existing affection of the œsophagus. When the body of the organ is alone implicated, it may be entirely absent, but in pyloric contraction it usually takes place at a lengthened interval after food. Loss of appetite is almost always present, and it shows itself, not only in the later stages, but at a comparatively early period in the disease. The loss of appetite is most marked in scirrhus, and it often forms a useful diagnostic sign, for in simple ulcer the appetite is generally unaffected. The tongue is usually dry, but thirst is seldom much complained of. The bowels are often confined in the earlier stages, from the imperfect muscular action of the upper part of the canal, but as the disease progresses diarrhœa frequently occurs, and tends to enfeeble the patient. The most striking feature of the disease is the steady and often rapid loss of flesh and strength that accompany it. We meet in the *post-mortem* room with no other examples of such extreme emaciation as are encountered in bodies after death from this disease. No case ever runs its whole course without this symptom manifesting itself. The lips become pale, and the skin often of a greenish, or slightly jaundiced hue. How are we to explain this cachexia, which seems always to occur in gastric cancer, although it is often not even marked in the malignant affections of other organs? No doubt, where there is a rapidly growing tumour, the wasting of the blood and the co-existing dischage from the seat of the disease, are sufficient to account for it. Where, as in scirrhus, these conditions are often absent, the chief cause of the loss of appetite, the failure in strength, and the change in colour, is the atrophy of the glandular structure of the stomach, which, as already pointed out, usually accompanies the disease. The pulse is ordinarily soft and feeble, for in this, as in other forms of cancer, an enfeebled condition of the heart, arising from a softened, fatty state of its muscular tissue, is commonly present. If fever is excited by the occurrence of any local inflammation, the pulse is, for a time, increased in force and frequency. Although the above are usually the symptoms of gastric cancer, the practitioner must not expect them to be always present. He may be called to a middle-aged or elderly man, in whom a rapid loss of flesh, strength, colour, and appetite are the only indications of the fatal disease under which he labours. The patient may assert that he has neither pain, nausea, flatulence, nor, in fact, any symptom pointing to a derangement of his gastric functions. The mere loss of appetite and strength in an elderly person should be sufficient to awaken suspicion, and demand a most careful exploration of all the abdominal organs.

Course and Duration.—Cancer of the stomach destroys life more rapidly than a similar affection of almost any other organ in the body, and it has been calculated that the average duration of the disease is about one year the maximum being thirty-six months, whilst the shortest period in which life is destroyed from the first symptoms being noticed is only one month. The encephaloid form is most rapid in its course, because its growth is quicker, and the neighbouring organs, such as the liver and lymphatic glands, are more often implicated. Colloid cancer is the slowest in producing death, and most of the more chronic cases have consisted of this form of malignant tumour. Severe hæmorrhage is more rare than in simple ulcer, but there is a greater tendency to a constant

oozing of blood from the ulcerated surface. The blood, thus slowly effused, is acted upon by the gastric juice, and when vomiting occurs, it is rejected like 'coffee grounds.' This appearance of the vomited matter used to be considered as pathognomonic of cancer, but it is now known that it only arises from the blood being slowly effused, and may, therefore, present itself in other forms of gastric disorder. Peritoneal perforation is more rare than in simple ulcer; but we more frequently meet with communication between the stomach and other organs, such as the colon. In such a case there may be stercoraceous vomiting, or diarrhœa may be excited by the gastric contents finding their way into the large intestine. Marked relief of the symptoms of cancer may be temporarily afforded by such a perforation, although this is not common. In still more rare cases adhesions occur between the stomach and the parietes of the abdomen, and an external opening is produced. As the disease progresses, other symptoms are generally observed. In some cases ascites occurs; in others œdema of the legs; in others jaundice is produced by the pressure of the enlarged glands on the gall-ducts, or by the implication of the liver itself.

*Physical Signs.*—The chief and most important physical sign presented by gastric cancer, is the presence of a tumour. Dr. Brinton calculated that it is present in 80 per cent. of all the cases, and probably this estimate is not far from the truth. It is usually well-defined, hard, and nodular; and not unfrequently isolated nodules can be felt in its neighbourhood. The sound on percussion is generally more or less tympanitic. The tumour is usually found in the epigastrium, or in the right hypochondriac region, more rarely near the umbilicus. As a rule, it is fixed, and does not move downwards with the respiration; but in some instances, where adhesions had not formed, it has been dragged downwards by the weight of the stomach, and has presented itself as low as the hypogastrium. It is most readily discovered when the pylorus, or the smaller curvature, is the part affected. Where the cardiac orifice is the seat of the mischief, the growth may be so deeply situated that, unless it is of large size, it may elude discovery. There are certain chances of error as regards a tumour caused by gastric cancer, against which we should be on our guard. Thus the swelling may arise from a feculent collection in, or from disease of, the colon. Again, cases are given where the stomach was found filled with string, hair, or cocoa-nut shavings, and in each case a tumour existed during life. The rectus muscle, when in a state of tension, may give rise to the sensation of a tumour, and it is only by altering the position of the patient that the mistake can be obviated.

The size of the stomach in gastric cancer varies according to the orifice affected, and in this way may prove a useful aid in diagnosis. When the pylorus is obstructed, the organ is usually enlarged; when the cardiac orifice is narrowed, the organ becomes decreased in size, and we derive less assistance from the examination of the vomited matters than might be expected. In dilated stomach they are in a state of fermentation, and contain sarcinæ and torulæ. Occasionally there are portions of cancerous masses, but, as a general rule, these are too much decomposed to afford satisfactory evidence. In one case observed by the writer, a number of particles of the intestine, with the villi attached, were discovered by the microscope in the rejected fluids, showing that the cancerous mass had invaded the duodenum. In some instances of doubtful cancer, the fluids vomited become quite solid when boiled with liquor potassæ; and this may prove a useful indication in certain cases.

Diagnosis.—In the earlier stages, and before the existence of ulceration, gastric cancer may be readily overlooked. We are apt to consider a person who complains of pain at the epigastrium, flatulence, and other symptoms of indigestion, as merely suffering from dyspepsia. The loss of appetite is, however, generally a more prominent symptom in the early stages of cancer than in dyspepsia, and if the patient be a person of middle age, and is rapidly losing flesh, the progress of the case should be most narrowly watched, and the abdomen frequently explored for any appearance of tumour. The chief difficulty in diagnosis is to distinguish cancer from simple ulcer; and it is often requisite to watch the case for some time before a decided opinion can be formed. As a general rule, the pain is more severe, more increased by food, and more relieved by vomiting, in cases of ulcer than of cancer. On the other hand, it is less fixed to one spot, and is more neuralgic in cancer. The vomiting is more immediate after food, when the cardiac orifice, and is longer delayed, when the pylorus is affected by cancer than in cases of simple ulcer. The fluids rejected in chronic ulcer contain no fragments of mucous membrane, although these may be present in acute cases, and the rejected matters do not solidify when boiled with liquor potassæ, as they sometimes do in cancer. In one doubtful case the writer ventured on the diagnosis of a simple ulcer, from finding in the fluids vomited a short time after eating a large amount of peptones. The patient, against all expectation, perfectly recovered. Severe hæmatemesis should lead us to suspect ulcer, frequent 'coffee-ground' vomit incline us to the diagnosis of cancer. Loss of flesh and strength, although present in both cases, is much more rapid and decided in cases of cancer; and, in like manner, where we can find no evidence of hæmorrhage from any organ, great pallor of the lips and throat should lead us to suspect it. Again, as cancer seldom appears in those below thirty-five years of age, and quickly destroys life, we should decide in favour of simple ulcer if the symptoms occurred in a young person, and had lasted for many years. The presence of a tumour, in case proper precautions have been used to prevent mistakes on this point, will settle the question in favour of cancer.

In doubtful cases, the distinction between a tumour of the stomach and colon may be sometimes assisted by the plan adopted in the following case. A patient was admitted into the London Hospital with a hard tumour below the left hypochondrium. As his symptoms did not

definitively point to gastric cancer, there was much difference of opinion as to the nature of the disease. The lowest edge of the tumour was first marked out with ink on the skin, when a considerable quantity of soap and water, well frothed, was injected by the rectum. The edge of the tumour was raised two or three inches, but its note on percussion was not clearer than before. As soon as the bowels had acted freely, the patient was requested to drink a pint of effervescing liquid, and now the edge of the tumour descended considerably, and the note on percussion became more tympanitic. From the injection into the colon raising the tumour, it was plainly not connected with the intestine, whilst from the percussion note becoming clearer after the drinking of the soda water, it was evident that it overlay, or was in some way connected with, the stomach. In all doubtful cases the stomach-pump should be used.

Prognosis.—The prognosis of any case of gastric cancer is always unfavourable. It is bad in proportion to the rapidity of the progress of the case; the early occurrence of the vomiting; the frequency of hæmorrhage; and the evidence that other organs, such as the liver, are also implicated.

Treatment.—There is not much to be expected in the treatment of this disease. Inasmuch as we are unable to check the progress of the malady, all our efforts must be directed to the relief of symptoms, and to support, as well as we can, the strength of the patient. Good and well-selected food, rest, and a fair supply of stimulants, often, for a time, appear to afford new strength to those overpowered by the disease. If the body of the stomach be the part affected, the indications for treatment are the same as in simple ulcer. When the pylorus is narrowed, the same plan must be pursued as when stricture of that opening has occurred from any other cause. Cardiac obstruction often brings with it the greatest misery to the patient. He is tormented with hunger which he is unable to appease, and death gradually approaches by starvation. In such cases the writer has in vain tried the application of ice-bags, belladonna externally and internally, and the hypodermic injection of morphia. So long as nutritive enemata can be borne they should be given, and if diarrhœa is produced by them small doses of laudanum may be mixed with them. In a case of this kind in the London Hospital, great relief was afforded by the passing of a narrow gum elastic tube into the stomach, and pouring through it liquid food. After the tube had been used for a little time the patient was able to take liquids, and gained considerably in weight; but eventually the opening became so constricted that the tube could not be made to enter the stomach.

6. **Stomach, Concretions in.**—Concretions in the stomach are composed of various indigestible substances that have been swallowed, such as hair, paper, cotton, cocoa-nut fibre, &c. They chiefly occur in idiots and lunatics. In some of the cases recorded a tumour has been observed during the life of the patient. Concretions of this kind may give rise to perforation, but more generally they set up inflammation of the mucous membrane, followed by peritonitis.

7. **Stomach, Contraction of.**—Contraction of the stomach may be general, or confined to one part. When general, the stomach is uniformly reduced in size. This condition is the result of long-continued abstinence from food. Thus, in disease of the œsophagus or of the cardiac orifice of the stomach we meet with it, and sometimes to such an extent that the organ is contracted to the size of the intestine. Again, when vomiting has been excessive and long-continued, as in acute gastritis, a diminution in capacity is observed. In all these cases, although the organ appears to be so much reduced in size, it readily assumes its normal dimensions when artificially distended. The stomach may be generally lessened by the contraction of a cancer or ulceration situated in the smaller curvature. The lessened capacity may be partly due to the small amount of food that could be retained on account of the constant vomiting, but it is chiefly owing to the drawing together of the orifices, which in extreme cases may be separated from each other by a very small space. Partial contraction of the stomach may result from the puckering up of the coats of the organ by the cicatrisation of an ulcer. Cases are recorded in which the stomach was divided, by the contraction of a cicatrix, into two distinct pouches, communicating with each other by a very narrow canal. Where the contraction occurs in the pyloric region, the contents of the stomach cannot be forwarded into the duodenum, and hypertrophy of the muscular structure, together with dilatation of the fundus of the stomach, is generally the consequence. *See* Pylorus, Diseases of.

8. **Stomach, Dilatation of.**—This may occur either in an acute or chronic form.

(1) **Acute dilatation.**—This form is exceedingly rare, and has attracted but little attention until of late years. The earliest case on record is that of a lady mentioned in the fourth volume of the *Pathological Transactions*, by Dr. Miller and Dr. Humby. She had been under treatment for piles shortly before her illness, and the abdomen had been observed to have increased in size. She was attacked with vomiting of immense quantities of fluid. The vomiting ceased four days afterwards, and the abdomen was found to be greatly enlarged. After death the cause of the abdominal distension proved to be the stomach, which was so much dilated that it was capable of holding 10 pints of liquid. Dr. H. Bennett, of Edinburgh, relates a similar case, and attributes the dilatation to a large quantity of effervescing liquid the patient had swallowed to allay his thirst. Dr. Hilton Fagge, in the *Guy's Hospital Reports* (vol. xviii. Third Series), describes two cases that had fallen under his notice, and also mentions that two similar cases had been observed at Guy's Hospital during fourteen years.

Diagnosis.—The signs of the dilatation, according to Dr. Fagge, are:—'1. A rapidly increasing distension of the abdomen, which is unsymmetrical, the left hypochondrium being

full, while the right hypochondrium is comparatively flattened. 2. The existence of a surface-marking descending obliquely towards the umbilicus from the left hypochondrium, and corresponding with the dragged-down lesser curvature of the stomach, this line appearing to descend with each inspiration. 3. The presence of fluctuation in the lower part of the abdomen. 4. The occurrence of splashing when the distended part of the abdomen is manipulated. 5. The presence of a uniformly tympanitic note over a large part of the distended region, when the patient lies flat on his back. Above the pubes, on the other hand, there may be dulness on percussion, simulating that of a distended bladder.

Treatment.—There is no doubt that the treatment recommended, and in one case employed, by Dr. Fagge is the proper one, namely, to empty the distended stomach as quickly as possible with the stomach-pump; and to maintain life by nutrient and stimulating enemata.

(2) **Chronic dilatation.**—Ætiology.—The most common causes of dilated stomach are conditions that prevent the egress of the digested food into the duodenum. 1. Cancer affecting the pylorus is the most usual cause. It may produce obstruction at the duodenal opening, either by the formation of a hard scirrhous ring, or by the projection inwards of fungoid growths. 2. The narrowing of the pylorus arises in some cases, not from malignant disease, but from fibroid thickening taking place below the mucous membrane; or more rarely thickening of the mucous membrane alone suffices to narrow the opening into the duodenum. 3. A simple ulcer near the pylorus, or the cicatrix of a healed ulcer, may cause the obstruction. 4. The pressure of tumours upon the pylorus or duodenum externally may prevent the due evacuation of the contents of the stomach. The tumours are usually of a malignant nature, but, more rarely, the same effect may arise from enlarged scrofulous glands. 5. The stomach may be displaced by adhesions, or the pylorus so dragged downwards that dilatation results. 6. The stomach may become dilated from paralysis of its muscular coat, produced, as in a case given by Dr. Wilks, by injury to the splanchnic nerves; or, as in an instance which occurred to the writer, from a fibroid change in the muscular coat. A certain amount of dilatation is by no means uncommon as a result of chronic catarrhal gastritis.

Anatomical Characters and Pathology.—When we lay open the abdomen, the stomach is found to be greatly increased in size, often so much so that it appears to fill the whole cavity. The greater curvature lies below the umbilicus, in extreme cases even as low as the pubes. The position of the pylorus varies according to the nature of the co-existing disease. Sometimes it is tied down by adhesions to its original site; at others it has been dragged downwards by the weight of the enlarged organ, and is situated at a much lower level. When the stomach is laid open, it is found partially or wholly filled with a dark-coloured frothy fluid, the amount of its contents being often enormous. The rugæ are effaced by the constant stretching, and the mucous membrane presents a level surface, which is generally more or less softened by the action of the acid contents upon it after death. Microscopically, the glandular structure is found to have suffered from the long-continued stretching. In one case the writer found the tubes visible, but widely separated from each other, the gastric cells being large and fatty. In another case the destruction had proceeded still further; a large proportion of the tubes had been destroyed, and were replaced by fibrous tissue, the muscular tissue being also thin and fibrous. In other cases the muscular structure proves to be in a state of hypertrophy, this condition being usually most distinct in the pyloric region.

Symptoms.—As, with the rare exceptions before noticed, where the dilatation occurs suddenly, the stomach only slowly enlarges, the symptoms manifest themselves very gradually. They are preceded by those of the malady which gave rise to the dilatation. Thus, the patient may for many years have suffered from the severe pain after food and vomiting indicative of ulceration; or frequent attacks of waterbrash, or flatulence and acidity, may have led to the suspicion of fibroid degeneration of the pylorus. Unless cancer should co-exist, there is seldom much complaint of pain, but a sensation of weight and fulness is usually experienced. More generally, attacks of heartburn present themselves, and a scalded feeling of the stomach and œsophagus annoys the patient. In some, there is a constant sense of craving referred to the epigastrium. Vomiting is almost always present, although it may be absent for considerable intervals. It does not occur, as in gastric ulcer, shortly after food, nor is there usually any complaint of nausea. The patient feels full and uncomfortable, often has a sensation as if fermentation were going on in the abdomen for two or three days, until he gets relief by the evacuation from the stomach of an enormous quantity of liquid. In other cases, the vomiting occurs more frequently, most generally at night, or towards the morning. He experiences great relief for a few hours or days, as the case may be, until the fluid again collects in sufficient quantity to produce discomfort. There is no great amount of straining during the attacks of vomiting, and if the abdomen be examined as soon as the act is terminated, the stomach is still found to be full. It seems, indeed, as if the contents were only partially pumped off by the action of the diaphragm and the abdominal muscles, the stomach itself being quite passive. In some cases hæmatemesis occurs, but this is rare, unless cancer be also present. The characters of the vomited matter are peculiar; usually they are of a more or less dark brown colour, very sour, edging the teeth and scalding the throat of the patient. When the liquid is allowed to stand, it soon becomes covered with a thick scum, and deposits a thick brown sediment. Chemically, it is found to contain various acids produced by the decomposition of the food. Microscopically, we meet with sarcinæ and torulæ in great abundance, intermixed with particles of partially digested food, and with mucus. In a few cases, bile is evacuated, but

this is an uncommon circumstance, and especially where there is a narrow stricture at the pylorus. Acid eructations are very common, and often more distressing to the patient than any other symptom. Thirst is usually complained of, and an excessive secretion of saliva is frequently remarked. The tongue has nothing characteristic. The appetite is bad where cancer co-exists, but in other cases it is good, often voracious. The bowels are almost always constipated, and the stools hard and knotty. The urine is usually acid, and often deposits an abundant sediment of lithates. The nutrition of the patient soon suffers, and loss of flesh and strength always accompanies the disease. Death eventually takes place by exhaustion, being not unfrequently preceded by swelling of the feet and legs.

*Physical Signs.*—The abdomen is perhaps distended, and covered with enlarged and tortuous veins. The shape is characteristic, the upper curvature of the stomach being visible as it stretches across between the false ribs, the epigastrium being hollow instead of prominent, and the abdomen much fuller on the left than on the right side. When, as is so often the case, the muscular coat is in a state of hypertrophy, the vermicular movements may be seen through the stretched and attenuated integuments. The movements are slow and gradual, proceeding usually towards the right side of the body. They are almost constant, but can be quickened by the application of cold or by galvanism. Too great stress must not be laid upon this symptom. Vermicular movements are visible in the parts above the stricture, whenever any portion of the gastro-intestinal tube is contracted. The sounds on percussion vary as the dilated stomach is full of air or of fluid. The tympanitic sound is best heard when it is only partially full. By changing the position of the patient, we are enabled to show that the fluid gravitates in the enormously dilated organ. By lowering the head and raising the hips and legs, we may generally define the lower boundary of the stomach, by the clear sound which is thus exchanged for a dull one on percussion. Bamberger asserts that, by placing the stethoscope over the stomach whilst the patient is drinking, we can hear the fluid fall into the distended cavity. This, in the writer's opinion, is of little value, for he has distinctly heard the passage of food through a stricture of the cardiac opening, where the stomach was smaller than normal.

Diagnosis.—With ordinary care, a dilated stomach is not likely to be confounded with any other abdominal disease. The chief points to bear in mind are—the large extent over which there is a tympanitic sound; the irregular distension of the abdomen; the hollowness of the epigastric region; the fulness of the left side of the abdomen; the vermicular motion apparent over the dilated organ; the peculiarity of the vomiting; and the large amount of fluid thus evacuated of an acid character, presenting under the microscope torulæ and sarcinæ. The diagnosis of the cause of the dilatation must be determined by the history of each case.

Treatment.—The indications for treatment are sufficiently evident, but unfortunately they are most difficult to meet.

*a.* It is evident that it is a matter of the first importance to keep the stomach as empty as possible, so as to allow of its contraction. This can only be effected by giving small quantities of liquid food at a time, and frequently. But it must not be forgotten that if the patient fails to fill the long-distended organ, a sensation of faintness and craving will be induced that will tempt him to set at defiance all our directions. Consequently, we may be often obliged to give way to his solicitations, and allow food of a solid character. The main point, however, is, as much as possible, to restrict the supply of food. In bad cases the writer finds it a good plan to order nutrient enemata, as well as small quantities of food by the mouth. *See* Enema. The plan of washing out the stomach, by means of a stomach-pump, with Vichy water or a strong alkaline solution, has not been so successful in the hands of the writer as he expected. In one case it had no appreciable effect in giving relief; and in another the patient complained so much of it that he was forced to abandon its use.

*b.* The muscular action of the stomach must be as much as possible facilitated. The writer has used galvanism, but with no ultimate benefit. Elastic abdominal belts may afford support to the overloaded organ. What, however, is always more or less beneficial is to keep up a free action on the large intestine by enemata. Injections of gruel and barley water, mixed with castor oil and turpentine, answer the purpose best.

*c.* Symptoms must be relieved as they arise. The subcutaneous injections of morphia are invaluable for the relief of pain. In some cases chloral answers better, but, on the whole, it is inferior to preparations of opium. One of the most distressing symptoms is acidity. This is best relieved by a combination of bismuth with magnesia or soda, or by lime-water given frequently. Sir William Jenner recommends the hyposulphite of soda to relieve the acidity. Others have recommended carbolic acid and creasote. The plan the writer has often adopted with success is, to restrict the patient to a diet from which all starch and sugar are carefully excluded. Thus, at breakfast we may give weak coffee, dandelion coffee without sugar or milk, and lime-water, always with gluten bread. The other meals, which should be frequent and very sparing, may consist of soup or animal broths, or—if it be thought advisable to allow solids—of mutton, game, chicken, or fish. No vegetables should be permitted, and the patient should be restricted to gluten bread or almond cake instead of wheaten bread. With such a diet, assisted by cod-liver oil, patients for a time may improve greatly, and gain both flesh and strength. In persons affected with dilated stomachs from atrophy of the muscular coat, lasting benefit may be obtained; especially if the complaint be recognised, and treated in a decided way.

9. **Stomach, Fibroid Thickening of.**—This condition has received various names, such as 'cirrhosis of the stomach,' 'sclerosis,' 'plastic linitis,' &c. Allusion has been made in another article to thickening of the coats of the stomach of a similar nature to that affecting the pylorus,

and usually producing hypertrophy of the muscular layer, narrowing of the opening into the duodenum, and eventually dilatation of the organ (*see* PYLORUS, Diseases of). Such cases, although not common, are every now and then met with, and in many instances the thickening of the submucous tissue extends for some distance from the pylorus, producing a tough, leathery condition of the coats. More rarely the thickening occurs in other parts than at the pyloric end. Thus, in one case of caries of the spine, the stomach was attached to the spinal column by a dense layer of connective tissue, which also involved the coats of the organ. Over the mass was a large ulceration with thickened base and edges. But apart from these local thickenings, we occasionally meet with a form of the disease, in which the coats of the whole organ are immensely hypertrophied.

ÆTIOLOGY.—Males seem to be more liable to this complaint than females, and it occurs at an earlier period of life than cancer. Dr. Brinton states that, whilst the average age of cancer is fifty, that of fibroid thickening is only thirty-four. Mechanical injury seems in some instances to have produced this disease.

ANATOMICAL CHARACTERS.— On opening the abdomen, there are almost always found signs of general peritonitis, either acute or chronic. In some cases a thick layer of lymph overlies and unites the various organs; in others only fluid, mixed with flakes of lymph, is discovered. The stomach is round or oval in shape, smooth on the surface, firm to the touch, and forming a tumour in the epigastric or hypochrondriac region. When cut into, its walls do not collapse; and its cavity is often so much reduced in size as to be capable of containing only a few ounces of fluid. The thickness of the walls varies greatly, but in some instances they have been described as upwards of an inch. As a general rule, they are thicker at the pylorus than elsewhere, but the opening into the duodenum is not necessarily constricted, although such is not infrequently the case. The coats are of a dirty grey colour, but the distinction between them can be readily made out. The chief seat of the thickening seems to be in the submucous tissue; but the muscular layers, as well as the connective tissue between the muscular bundles and the subserous structure, are all much increased in thickness and density. The mucous membrane is thrown into folds or elevations, or studded over by small projections, most of these appearances being probably the result of the diminished capacity of the organ. Microscopically, the mucous membrane is usually found healthy. All those who have examined such cases have come to the same conclusion, namely, that the connective tissue alone is universally increased in thickness, and that there is an absence of any indication of cancer.

SYMPTOMS.—In a case observed by the writer the symptoms followed immediately after the receipt of an injury to the epigastrium; but usually they have come on insidiously. There is generally pain in the epigastrium, increased by food, in some instances shooting into the back and shoulders. The tumour formed by the thickened stomach is almost always tender on pressure, but not remarkably so, unless peritonitis is present. Vomiting is a general symptom; in some it occurs directly after food, in others the fluid rejected is thin, like saliva. Towards the close of the disease vomiting of blood is not unfrequent, but, unless ulceration occur, there is an absence of the coffee-ground fluid so constantly marked in cancer. The appetite is always bad, and decreases as the disease advances; the bowels are usually confined. There is loss of flesh and strength; the pulse is feeble towards the end of the case; dropsy, both of the peritoneum and lower extremities, generally shows itself; and the patient dies from exhaustion, or is cut off by the occurrence of peritonitis. The duration of the malady varies greatly. In some cases it has been known to last for many years, whilst in others the patient has died in a few months.

*Physical Signs.*—In almost every instance a tumour has been observed during life. It is generally situated in the epigastrium, but may present itself in either hypochondrium. In one patient it was supposed, from its situation, to be a cancer of the spleen. It is smooth upon the surface, more or less tender to the touch, and usually movable from side to side. On percussion, the sound is not perfectly dull, as in the case of a solid tumour.

DIAGNOSIS.—This complaint may be confounded with cancer, or with foreign bodies in the stomach. It must be most difficult, if not impossible, to diagnose the more acute cases from cancer. The smoother surface of the tumour, and the non-affection of the liver or other organs, are the most likely points on which stress may be laid, to distinguish between the two diseases. In the chronic cases of fibroid thickening, the long duration of the illness, the less constant pain, the vomiting directly after food, the less frequent occurrence of coffee-ground vomiting, and the absence of the history of a family predisposition to cancer, may afford some grounds for a diagnosis. To distinguish these cases from foreign bodies in the stomach, we must remember that the latter are found chiefly in idiots and in the insane, or in hysterical females. The writer has long been in the habit of distending the stomach in all doubtful cases, by making the patient drink freely of soda water; and in one instance where the coats of the stomach were much thickened, he succeeded by so doing in proving the case to be one of fibroid disease. The note on percussion became more tympanitic, and the lump descended, but in the case of a foreign body in the stomach no change would be effected by such a manœuvre.

Thickening of the walls of the stomach may, as just said, closely simulate cancer. It is necessary therefore that we should be on our guard against such a mistake. Although fibroid thickening of the stomach is very rare, yet we should not be too hasty in giving a settled opinion until the presence of a tumour, attended by other general and physical signs, leaves little doubt as to the correctness of the diagnosis.

TREATMENT.—Careful attention to diet is the most essential point in the treatment of this disease. The diminution in the size of the stomach is sufficient to show that only small

quantities of food can be retained, and the impaired condition of the motor apparatus indicates the necessity that the nourishment should consist only of liquids. Milk and animal soups seem best fitted for such cases. Opium is almost the only medicine likely to be of value; but occasional leeches, and small blisters, frequently repeated, to the epigastrium, tend to relieve the sufferings of the patient.

10. **Stomach, Gangrene of.**—It is supposed by many modern authors that ulcerations of the stomach are produced by the solution, by means of the gastric juice, of small patches of the mucous membrane that have been deprived of their vitality, and become gangrenous. Such may no doubt be the case, when the morbid condition is confined to merely isolated patches of the stomach; but where acute gastritis coexists, there is a complete suspension of the secretion of gastric juice, and the writer has in such cases seen the edges of the sloughing tissue still remaining attached to the neighbouring healthy structures. Where there has been great depression of strength we occasionally meet with sloughing, to a considerable extent, of the mucous membrane of the stomach, both in the inferior animals and in man. Cases of sloughing of the stomach occurring in the human subject have been recorded by various authors. Dr. Habershon mentions one in which, along with diseased kidneys and pneumonia, there were several sloughs at the lesser curvature of the stomach, 'the longest two inches in length and about one in breadth, black and slightly raised; a section showed that the slough was situated in a sort of cup of slightly thickened tissue. Two smaller sloughs were situated near to it.' The most ordinary form of gangrene of the stomach is where it occurs in cancer of the organ. A large mass of sloughing tissue is found connected with a malignant ulceration, often of large size, and generally situated towards the pyloric end of the organ.

Treatment.—Gangrene of the stomach is beyond treatment.

11. **Stomach, Hernia of.** *See* Stomach, Malpositions of.

12. **Stomach, Hyperæmia of.**—The mucous membrane of the stomach is frequently found to be congested after death, where there has been but little evidence of disease during life.

Ætiology and Anatomical Characters.—Gastric hyperæmia may arise from different causes. If an animal be killed when fasting, the lining membrane of the stomach is found to be pale and anæmic; but if death should occur whilst digestion is going on, the vessels are seen to be filled with blood. The same thing is observed in the human subject, and serves to explain the frequent occurrence of a congested state of this organ after death. In other instances the increased vascularity is the result of a lavish employment of alcoholic stimulants during the later hours of life. The most extreme degrees of hyperæmia of the stomach are met with in cases of diseased heart, more especially when the mitral valve has been constricted. When we open the stomach we are at once struck with the dark, purple condition of its lining membrane, the appearance of congestion being most evident in the pyloric region, and terminating abruptly at the end of the œsophagus. The rugæ seem thick and prominent, and the whole surface is covered with a layer of tenacious mucus. Spots of extravasated blood present themselves, some being softened on their surface, as though they had been acted upon by the gastric juice. There is, however, seldom any of the general softening characteristic of the action of the gastric juice after death, and the surface looks raw and uneven after the removal of the adherent mucus. The whole stomach has a thickened, fleshy feeling, and is, in reality, considerably increased in bulk. In three males who died of heart-disease the average weight of the gastric mucous membrane was found to be 1,026 grs., and in three females it amounted to 800 grains. As the average weight in fifteen males, who had died of other diseases, was 864 grains, and in thirteen females 530 grains, it is evident that the bulk is greatly increased in hyperæmia. Microscopically, sections of the stomach have an opaque appearance, from the quantity of blood and serum they contain, but, after being for some time macerated, they are more transparent. In some cases the tubes can be readily separated from each other, and are normal; but in others they are of unusually large size, and distended with cells and granular matter. The blood-vessels are always enlarged, and in long-standing cases the coats of the veins are thickened. The capillaries surrounding the orifices of the tubes, where the backward pressure of the blood must be chiefly felt, on account of their want of support, are especially dilated and engorged with blood. Long-continued congestion produces the same effect in reducing the secretion of the stomach, as it does on that of the kidneys and other glandular organs. The secretion of acid is evidently lessened, for in some instances phosphates have been found in the contents of the stomach, and, as a general rule, the mucous membrane does not present the appearance of *post-mortem* solution. But the formation of pepsin is also impaired. The writer made an artificial gastric juice from the mucous membrane of three males dying of heart-disease, and found only 2·9 grains of albumen were, on the average, dissolved, whilst the average amount digested by the mucous membrane of persons who had died of other maladies was 4 grains. In the case of three females a still smaller amount of solvent power was displayed. In one only 2 grains were digested, and in the other two scarcely any effect was produced upon the albumen. There can be, therefore, no doubt that long-continued congestion of the gastric mucous membrane not only produces anatomical changes, but also diminishes the characteristic secretion of the organ. The question may be asked why hyperæmia is more intense in the pyloric than in the more actively secreting portions of the organ? In all probability it arises from the fact that the vessels of the stomach perforate the muscular coat obliquely, before they pass upwards between the tubes to the surface. The circular fibres must compress these vessels during their contraction; and the veins, from the greater tenuity of their coats, and from their not being protected by

surrounding fibrous tissue, must feel the effects of the compression more than the arteries. But the transverse muscular fibres are comparatively thin and weak in the larger portion of the stomach, and become firmer and stronger as we approach the pylorus. Consequently, the veins are more liable to compression during the more energetic motions of this region, and the effects of the congestion are here more appreciable.

**13. Stomach, Hypertrophy of the Walls of.** *See* Stomach, Fibroid Thickening of.

**14. Stomach, Inflammation of.**—Synon.: Gastritis; Fr. *Gastrite*; Ger. *Gastritis*.

All the coats of the stomach may be simultaneously inflamed, but this is rarely met with, and the cases in which it occurs are referred to under other headings (*see* Stomach, Fibroid Thickening of). Usually the mucous membrane is alone the seat of the disease, and it has of late years been the custom to describe this as 'gastric catarrh.' This term is objectionable, as catarrh is so generally applied to the inflammation of mucous membranes of a much more simple anatomical structure. It should be borne in mind that the mucous membrane of the stomach is in reality an expanded gland, the elements of which have a greater functional activity than those of any other secreting structure in the human body. The injuries inflicted upon it by disease are therefore in no way analogous to those suffered by an ordinary lining membrane, but tend to lessen or altogether destroy the function of an organ of primary importance to the well-being of the individual. In addition to this, the anatomical changes are not always of the same character, but seem to the writer in certain cases quite distinct from those ordinarily produced by catarrh. Inflammation of the mucous membrane of the stomach will therefore be described under two forms, namely, (1) *Catarrhal*; and (2) *Erythematous* gastritis. It will be also necessary to consider the disease according as it occurs in an *acute* or *chronic* form.

**(1) Acute Inflammation—Acute Gastritis.**

Ætiology.—Acute *catarrhal gastritis* is most common in persons of middle and advanced age, and it more frequently affects females than males. Sometimes it occurs in gouty and rheumatic subjects, and is relieved when the disease appears in the joints. Again, it presents itself in those who suffer from disease of the heart, emphysema of the lungs, cirrhosis of the liver, and other disorders that have a tendency to keep up a congested condition of the digestive tract. Under these circumstances it often proves very dangerous, and snaps the feeble thread by which the patient clings to life. The most common causes are, however, errors in diet; various indigestible substances, such as cheese or shell-fish, being especially liable to produce it. Above all, an immoderate indulgence in spirituous liquors is apt to set up this form of inflammation, not infrequently laying thereby the foundation for other and more serious morbid changes.

Acute *erythematous gastritis* is more generally met with in children and in young persons, and constitutes a considerable number of the so-called 'gastric' and 'remittent' fevers so common at this period of life. It also presents itself in scarlet fever and other eruptive disorders, and although it usually passes off without provoking any local symptoms during the fever, it nevertheless constantly leaves a liability to a frequent recurrence of the disorder. Considering how often the recurrence takes place, it is strange that so little attention has been attached to the circumstance. A similar morbid condition of the stomach often makes its appearance in the last stage of phthisis and other exhausting disorders, and adds greatly to the danger and sufferings of the patient.

Anatomical Characters.—In *catarrhal gastritis* the stomach is usually contracted and empty. The lining membrane is covered with a tenacious or thready mucus, beneath which it appears irregularly congested. It is softer than usual; and often presents numerous small hæmorrhages. These are most commonly met with in the pyloric region, are round or oval in shape, and frequently superficially ulcerated. Microscopically, the pits on the surface of the membrane are found to be swollen, prominent, and their vessels are much congested. On section, the gastric tubes are seen to be greatly distended with large granular cells, which, by their increased size and number, bulge outward the basement-membrane, so as to produce an irregular outline. The solitary glands are greatly enlarged.

We meet with the most perfect examples of acute *erythematous gastritis* in scarlatina. In the earlier stages there is no increased secretion of mucus, and often but slight injection of the surface, whilst at a later period the mucous membrane may be even paler than usual. Microscopically, the gastric tubes are much distended by granular and fatty matters, so that the cells are quite obscured, and in many cases these seem to be reduced greatly in number. Casts of the tubes are in some instances met with in the contents of the stomach. It will be observed that the morbid appearances, which are strictly analogous to those of the skin in scarlatina, differ from those produced by catarrh, in the amount of mucus not being increased, and in the tubes being distended by an albuminous fluid, instead of by an increased growth of the cells themselves. It is therefore analogous to an erythematous affection of the skin, with which, indeed, it is associated in scarlatina; whilst the catarrhal form is analogous to the eczematous and other inflammations of the cutis, which are characterised by a more abundant formation of the cellular elements.

Symptoms.—The *catarrhal* form of gastritis is sometimes preceded for a few days or hours by a feeling of general weakness; in other cases the attack comes on without warning. There is seldom any complaint of pain in the region of the stomach, although a sense of fulness and uneasiness is not uncommon. Vomiting is always present, and constitutes one of the most characteristic signs of the disease. At first any remains of the previous meal are rejected, but afterwards a thick, glairy mucus is expelled, attended with violent retching. The tongue is foul, and the breath often offensive, from the coexistence of oral catarrh. There is an absence of

appetite, or a positive aversion to all food. The bowels are confined; the urine, which is often pale and copious before the attack, becomes scanty and high-coloured during its continuance. The pulse is rarely quickened, and the temperature of the skin unaltered. There is almost always headache, the pain chiefly affecting the forehead and eyes, and being accompanied by intolerance of light and sound.

In *erythematous* gastritis, on the contrary, pain at the epigastrium is a prominent symptom, excepting when the disease accompanies eruptive fevers. It usually comes on directly after food, sometimes shooting into the shoulders, or down the left arm In phthisical cases a feeling of rawness in the œsophagus and stomach is more generally complained of. The pain is associated with tenderness on pressure over the pit of the stomach. In children there is usually an absence of pain, but the tenderness is well-marked. Vomiting is as general as in the catarrhal form, but the matters rejected seldom contain much mucus. Nausea is present where vomiting is absent, and in the slighter cases forms the chief ground of complaint. Thirst is almost always troublesome; the tongue is at first red and injected, but in a day or two is apt to become dry and glazed. Diarrhœa generally accompanies the disease, the stools being fœtid and unhealthy. The pulse is quick, often out of all proportion to the severity of the other symptoms. The temperature of the skin is increased, especially in children.

Both these forms of gastritis generally subside, but in other cases the disease shows a tendency to become chronic. In both there is a diminution, or entire cessation, of the secretion of the stomach. This does not arise from any deficiency in the amount of pepsin in the tubes, for the writer has found the mucous membrane after death capable of forming an active artificial gastric juice. In all probability, the secretion of acid is arrested, or its flow into the stomach prevented, by the swelling of the orifices of the tubes or of the pits into which they open. The result, however, is that fermentation occurs in any food that may be placed in the organ; the inflammation is thereby kept up; and large quantities of torulæ, mixed with food or mucus, are rejected by vomiting.

Diagnosis.—The vomiting of acute catarrhal gastritis, attended, as it so frequently is, by headache, is apt to be confounded with the gastric irritability of brain-disease. In affections of the brain the vomiting occurs more directly after food, and is often unattended by nausea. The tongue may be clean, whilst the pulse is quick, the skin hot, the bowels obstinately confined, and other symptoms are present pointing to some brain-lesion. In gastritis the nausea is more complained of; the tongue is foul; the pulse, in the catarrhal form, but little quickened; the skin comparatively cool; the bowels often relaxed; and there is a history of previous attacks, or of some dietetic error or co-existing visceral disorder. Acute erythematous gastritis may at first closely simulate typhoid fever, especially in children. It is, however, distinguished from it by the gastric symptoms being prominent from the onset; by their sudden occurrence; by the rapid, not gradual, rise of the temperature; by the red, injected tongue; and by the spleen not being enlarged. The fall in the temperature, and the absence of eruption and of diarrhœa, serve to prevent mistakes after the first week of the illness.

Prognosis.—When gastritis is uncomplicated, the prognosis is favourable, but it is otherwise if it take place in the course of some serious chronic disorder.

Treatment.—The general principle to be kept in view is to afford the stomach as perfect physiological rest as possible. In severe cases, therefore, it is best to let the patient abstain entirely from all food for twenty-four or forty-eight hours, allowing him to suck only a little ice, in order to allay thirst. If there be much exhaustion, or if the attack be a protracted one, the strength may be supported by nutrient enemata. Sometimes the subcutaneous injection of morphia assists in giving rest to the inflamed organ. In acute catarrhal gastritis, especially when it is attended with portal congestion, or has arisen from excessive indulgence in spirituous liquors, we can often put a stop to the attack by calomel. Five grains may be placed on the tongue, and be followed by a saline aperient, or a second dose may be administered the following day. When there is diarrhœa or much exhaustion, it is a good plan to give a grain every few hours. In the slighter attacks effervescing liquids often give great relief to the patient. In the earlier stage of erythematous gastritis, nitrate of potash or muriate of ammonia, along with hydrocyanic acid, is generally of benefit; the bowels being at the same time relieved by some mild aperient, or by an enema.

In both forms the practitioner should be on the watch, lest the symptoms should be kept up by fermentation. This is readily determined by placing a drop of the vomited matters, mixed with a weak solution of iodine, under the microscope. Torulæ, if present, will be detected by their brown colour, round or oval shape, and their tendency to the formation of chains of cells. In case of fermentation, carbolic acid, creasote, or sulphurous acid may be prescribed. The glycerine of carbolic acid, in doses of ten or twelve drops, is to be preferred, combined with tincture of belladonna or solution of morphia. In other cases the sulphurous acid seems to answer better.

Occasionally the vomiting appears to persist from exhaustion. When this is suspected to be the case, stimulants must be had recourse to, and the writer has seen champagne stop sickness at once, when all other remedies had been fruitlessly tried. It is in such circumstances that the hypodermic use of morphia is so valuable; a single dose often giving sleep, and allowing the stomach sufficient repose to recover its normal tone.

When there is much epigastric tenderness, the application of a few leeches is often of great value. This is chiefly the case where the attack has occurred as a complication of some other gastric disorder, such as ulcer. In obstinate cases of catarrhal gastritis, dry-cupping may be used with benefit. In the erythematous form we always find warm external applications useful, such as poultices of linseed meal, with or

without mustard, hot fomentations, and in some cases stimulant or opiate liniments.

When it is considered advisable to allow food, it should be in the form of liquid. It should be given in small quantities at a time, and be often repeated. In catarrhal gastritis all saccharine and starchy fluids should be avoided, on account of their tendency to ferment. It is best to restrict the patient to chicken-broth, or mutton or beef-tea, or milk mixed with soda, Vichy, or Seltzer water. In the erythematous form, where there is less tendency to fermentation, barley-water, arrowroot, or other farinaceous food mixed with milk, may be used. It often happens that condensed milk is tolerated where cow's milk is rejected.

(2) **Chronic Inflammation; Chronic Gastritis.**

This is, perhaps, the most common disease met with in practice, and comprises all the forms of chronic gastric derangement usually described under the head of 'inflammatory dyspepsia.' It is almost always of a catarrhal nature, for when signs of erythematous gastritis present themselves, it will generally be found that the latter affection is an acute attack supervening on chronic changes of a catarrhal nature.

Ætiology.—Men are more subject to chronic gastritis than females; and amongst the working classes, the writer found it was most frequent in men between forty and fifty, and in women between fifty and sixty. In a large proportion of the cases that occur in early life it is an hereditary disease, and the mother is much more apt to transmit it than the father. It often results from attacks of acute inflammation. Persons of a full habit of body are more especially liable to chronic gastritis, and it is in such that the complaint usually proves especially rebellious to treatment. Of all causes, errors in diet are most apt both to induce it, and to maintain it when once it has been lighted up. Thus, a too free supply of animal food is one of the most potent causes, and equally so is the habit of too frequent repetition of meals, without allowing a sufficient interval between them. This habit of eating too frequently is greatly kept up by the craving which is so common a symptom of the disease. Imperfect mastication is another common cause; but, above all, the immoderate use of alcohol occupies a prominent place. It is strange how frequently we discover signs of chronic gastritis after death, where no particular complaint has been made of any derangement of the digestive organs. This is more especially the case where cirrhosis, chronic congestion of the liver, diseased heart, and other disorders tending to obstruct the portal circulation, are present. In like manner, it is apt to occur whenever any excretory organ is performing its office imperfectly, as in chronic diseases of the kidney, or when constipation, or inactivity of the skin exists. It is very common in gouty subjects, and in females who suffer from catamenial derangements. It is often met with in persons who have died of phthisis and other wasting disorders.

Anatomical Characters.—The mucous membrane of the stomach is covered with a layer of greyish white, tough, transparent mucus, which firmly adheres to the surface. On its removal an abnormal amount of vascularity becomes apparent, the veins being large and prominent. The surface is often of a grey or slate colour, and not unfrequently numerous hæmorrhagic erosions present themselves. This is more especially the case where long-continued congestion has been kept up by cardiac or hepatic disease. In other cases the surface is strikingly uneven, being studded over with numerous little prominences, separated from each other by shallow furrows. This condition is named 'mammillation.' More rarely, small polypoid formations project from the membrane. The whole membrane is firm and tough, and can be stripped away from the subjacent structures in flakes of considerable size. These anatomical changes are more common in the pyloric region than in the more actively secreting portions of the organ.

Microscopically, in the slighter cases the anatomical changes may be limited to enlargement and thickening of the small pits on the surface, together with dilatation and congestion of the blood-vessels. But when the disease has been of long standing, a section shows the glandular structure itself to have participated. The secreting tubes are closely united together, and to the subjacent coats; their basement-membrane is greatly thickened; and they are distended with cells and granular matters, which often project like little lumps from their orifices. At a later stage the tubes become atrophied, and only a few fatty cells remain to point out their former site; or their free ends are obstructed, whilst their lower ends are dilated into a flask-like form. The grey pigment may be deposited either between the tubes or in the cells themselves. The solitary glands are generally enlarged, and tend to atrophy the tubes by their pressure. Patches of thickened layers of epithelium may remain attached to the surface, showing that a condition may exist in the stomach analogous to squamous diseases of the skin.

Symptoms.—There is a great difference amongst authors as to the symptoms produced by chronic catarrhal gastritis. This, no doubt, in part, arises from the fact that simple and uncomplicated cases are so rarely fatal, and that we have, therefore, but few opportunities of verifying the diagnosis by *post-mortem* examination. But it also depends on the symptoms of other co-existing affections being so often described along with those arising from the deranged stomach. There is seldom much complaint of pain, excepting it be a sense of fulness and oppression at the epigastric region after food. When there is acidity, the patient often experiences a severe burning from the stomach to the throat. In such cases temporary relief may be afforded by food or stimulants, on account of the introduction of fresh aliment exciting the stomach to increased action, so that the decomposing remains of the previous meal are either neutralised or hurried through the pylorus. There is generally a certain amount of tenderness at the pit of the stomach, which is most evident in the cases in which congestion of the liver is also present. The appetite is variable, being usually lessened, but in other cases a craving for food is experienced. Nausea is a common symptom, but vomiting, in the ordinary run of

cases, is not so frequent as might be expected. When the affection has been induced by drunkenness, a rejection of mucus in the early morning takes place, and in gouty subjects this forms a most distressing symptom. Acid eructations, and a sour taste in the mouth, are commonly complained of. These probably arise from particles of undigested food remaining entangled in the mucus, setting up acetous fermentation in the saccharine and starchy articles of diet. The writer prevailed upon a number of patients who were suffering from this symptom to excite vomiting in the early morning by drinking warm water. In every case a quantity of thick, ropy mucus was rejected, and intermixed with it were portions of partially digested food. In some the amount of fluid rejected was so large that the conclusion could not be resisted that the muscular coat had been enfeebled by the inflammation, and had been thus unable to completely expel its contents. Thirst is often present, and, as a general rule, is most complained of towards evening. The bowels are usually confined, but where the catarrhal condition has extended to the intestines, frequent attacks of diarrhœa take place. The urine is high-coloured, depositing lithates; but as the inflammatory condition subsides, it may become of low specific gravity, alkaline or slightly acid, and may deposit pale-coloured lithates or phosphates. Where the oral cavity is, as is usually the case, also inflamed, the throat presents a red, congested appearance. The tongue is large, indented with the teeth, and if the liver is simultaneously congested, is coated with a thickened epithelium of a brown or yellow hue. If the catarrh have extended to the salivary glands, the surface of the tongue becomes dry, or is covered with a white, creamy mucus. If the duodenum be affected, the patient is liable to jaundice from obstruction of the biliary passages; more generally the results of imperfect lacteal absorption are shown in the loss of flesh, dryness and harshness of the skin, and imperfect nutrition of the hair and nails. The pulse is ordinarily slow, full, and regular. A short cough is often complained of, from coexisting laryngeal irritation. The temperature is seldom increased, excepting towards evening, and the patient often complains of coldness in the extremities. The nervous system almost always suffers. There is great watchfulness, or the patient wakes after a few hours of broken and disturbed slumber. Attacks of headache are frequent, the pain affecting chiefly the forehead and eyeballs.

It is necessary to notice two important varieties of the complaint, both on account of their practical importance, and also from the little attention they have received from authors. In one class of cases the prominent symptom consists in the rejection of an enormous quantity of mucus. This may occur almost constantly, vast amounts of glairy or of blood-stained mucus being rejected. In other instances the vomiting occurs only every few days, mostly after breakfast; and, from the quantity expelled, it would almost appear as if a gradual accumulation took place between each attack, until the stomach was excited to get rid of it. There is often no nausea preceding the vomiting, and but few gastric symptoms between the attacks. This form of gastric catarrh is most apt to occur in females, but it may also affect the other sex. The second variety appears to be an eczema of the stomach; at any rate, the catarrh of the mucous membrane replaces a similar catarrhal condition of the skin, and is often relieved as soon as the latter reappears. In many cases the condition may be attributable to a gouty diathesis, of which both the skin-affection and that of the stomach are but the expressions. Still, this alternation between the disorder of the skin and stomach is not infrequently witnessed in practice.

Diagnosis.—The only disease likely to lead to mistakes in diagnosis is atonic dyspepsia; but we may meet with very rare cases of chronic catarrhal gastritis that are difficult to distinguish from ulceration and cancer of the stomach. Where, as occasionally happens, a certain amount of hæmatemesis presents itself, the diagnosis between this disease and ulceration requires care. But in catarrh, there is usually some co-existing disease of the heart or liver, or some disorder of menstruation; there is an absence of pain, or, if pain be present, it is relieved, not increased, by food, as in the case of ulcer. Again, the vomiting is less excited by food; the epigastric tenderness is slight and diffused, not confined to one particular spot, as in ulcer. Cases are sometimes mistaken for cancer. The pain, however, in gastric catarrh is slighter; the tenderness comparatively trifling; and the hæmatemesis never excessive or long-continued, as in cancer. On the other hand, in the latter disorder there is a more rapid loss of flesh and strength, and more pallor of the lips and complexion. The discovery of a tumour in the epigastric region, or in some other organ, would remove all doubts as to the real nature of the malady.

Treatment.—The first point in treatment is to discover, if possible, the cause of the disease. It is useless to attempt to relieve an inflammation of the stomach, so long as the veins of the organ remain in a state of congestion produced by a disease of the heart or lungs. Cases that had been ineffectually treated for months with purgatives and tonics, yield at once to rest and digitalis, prescribed on account of the discovery of a dilated heart. In other instances, chronic Bright's disease, by preventing the due elimination of the effete matters, gives rise to the gastritis; and, under such circumstances, treatment directed to the relief of the original affection yields more satisfactory results than that which would be ordinarily prescribed for inflammatory dyspepsia. Constipation will be often found to have preceded the gastric symptoms, which have been produced by the food being too long retained in the stomach, from the diminished muscular activity of the whole canal. Here a regular action of the bowels is the main indication for the relief of the gastric catarrh. There is often, as before mentioned, a craving for food every two or three hours, set up by the presence of mucus in the stomach. Numbers of cases prove rebellious to treatment, because the patient persists in seeking temporary relief by frequently cramming the stomach with food, or because he keeps the

mucous membrane in a state of excitement by stimulants, taken under the idea that debility is the cause of his sufferings. In the majority of very obstinate cases, one or other of these habits requires to be overcome, before other treatment can be made available. The mere removal of the cause producing the disease is often sufficient to ensure its cure, but in other instances we are forced to employ other means. The chief indication in the ordinary run of cases is to take off any increased pressure upon the venous circulation. In any glandular structure we can only effect this object by lessening the amount of blood flowing to it, or by increasing the rapidity of the circulation through the organ by stimulating its secretion. The first of these objects in the case of the gastro-intestinal tract is accomplished by purgatives, which drain away a large quantity of the liquid portions of the blood which has to pass through the vena portæ. In young and vigorous subjects, therefore, salines, such as the sulphate of magnesia, the tartrate of soda, or the mineral waters of Pullna or Friedrichshall, may be employed. These may be assisted by small doses of mercurials, given every second or third night. The salines should not be too long continued alone, as they are apt to enfeeble the muscular powers of the canal. After a short period, it is necessary to combine them with a tonic, such as quinine or calumba, or with sulphate or phosphate of iron. In more feeble subjects, or in those who have previously suffered from atonic dyspepsia, it is better to relieve the congestion by stimulating the biliary secretion. For this purpose, taraxacum or chamomile may be employed, assisted by a pill each night, containing podophyllin or blue-pill. In another set of cases, where the patient is not robust, both objects may be attempted at once—by the administration of soda and rhubarb in the day, assisted by an occasional dose of blue pill at night, or by a course of the Carlsbad water every morning.

It has been before remarked how readily fermentation is set up, whenever the secretion of the gastric juice is lessened or arrested. This circumstance must be borne in mind in the treatment of this as well as of other gastric disorders. As soon as the more urgent symptoms of chronic gastritis are subdued in any case, tonics, such as iron, calumba, or quinine, along with acids, may be used to obviate the enfeebled state of digestion that always results from the long continuance of the inflammation.

The treatment of cases where immense quantities of mucus are vomited must be conducted on a different principle. Here the venous system is in a state of passive congestion, and no active inflammation of the mucous membrane is in progress. We must use astringents, the best of which are bismuth, nitrate or oxide of silver, oxalate of cerium, kino, tannin, and opium. Purging makes the patient worse. In order to obviate the ill-effects of the astringents it is necessary to give each night a pill of podophyllin and creasote, or of nux vomica and aloes, or some other similar preparation. The disease has been relieved by placing around the abdomen a fold of flannel dipped in dilute nitro-hydrochloric acid, and covered with india-rubber cloth.

Eczema of the stomach is most difficult to treat satisfactorily, probably because it depends on the general state of health. It is best relieved by moderate doses of solution of potash, taken a little before the time when the scalding pain is expected, assisted by a pill, every night, of podophyllin and creasote. As soon as the urgent symptoms have been overcome, benefit may be expected, either from the compound iron mixture, or from quinine combined with ammonia. Flannels dipped in a solution of common washing soda, and covered with india-rubber, may be applied over the epigastrium with benefit; or a liniment of croton oil may be employed. The latter must be used with great caution, as, from the unusual irritability of the skin, the eruption is apt to be very severe.

Theoretically, it might be expected that a farinaceous diet would not be suitable in these cases; inasmuch as it is apt to set up fermentation. It is better to confine the patient to sparing meals of mutton, chicken, game, or fish along with bread. Vegetables and fruit should be at first avoided, but may be freely used as soon as the more urgent symptoms have subsided. The breakfast is the most difficult meal to manage, for tea and coffee are apt to disagree and increase the mischief. Dandelion coffee is often very useful in such cases. It is made by boiling the roasted and dried root of the taraxacum with a quarter of its weight of the best coffee. Where this cannot be readily obtained, the succus taraxaci of the Pharmacopœia may be taken, along with weak coffee. If milk does not disagree, it may be used, mixed either with lime-water, Seltzer, or Vichy water. Alcohol should be avoided, but if from long habit or other circumstances its use is necessary, a small quantity of weak spirit and water should be substituted for wines.

15. **Stomach, Malposition of.**—The stomach may be displaced congenitally; or as a result of accident or disease.

In congenital displacement the stomach may be situated on the right side of the body, the fundus pointing to the right hypochondrium, the pylorus to the left. But, as in such cases it will be also found that there is a similar malposition of the heart, liver, and spleen, no mistake in diagnosis is likely to occur. As a congenital condition, the stomach may occupy the left pleura, through a partial arrest of development of the diaphragm. It may be also situated in the left pleura, owing to a rupture of the diaphragm. It is said that such a state has given rise to a mistake in diagnosis between it and pneumothorax of the left side. In both there is a clear sound on percussion, and a gurgling produced by motion of the body. Besides this, the pressure of the distended stomach has been seen to displace the heart, and produce dyspnœa. Bamberger has pointed out that in protrusion of the stomach into the left pleura the respiratory sounds can be heard in the upper part of the left lung; the clear note on percussion becomes duller after food; and any metallic sounds that may present themselves are unconnected with the breathing of the patient. The dyspnœa of congenital displacement is only occasional, not persistent, and it will be found to have existed for years, in-

stead of occurring suddenly, as in pneumothorax. When the hernia has resulted from an accident, it is usually accompanied by vomiting of fluid containing sarcinæ, and by other signs indicating that the stomach does not get freely emptied of its contents. The organ may be displaced downwards by the weight of a tumour situated in its coats. This is more especially the case with the pylorus, which is generally the seat of such a morbid change. Under these circumstances, the pylorus may be so depressed as to occupy the right iliac region, or it may have fallen still lower, and be united by adhesions to some of the pelvic viscera. In some cases the stomach is found in the contents of large umbilical and scrotal herniæ. An interesting case of this nature is recorded by the late Mr. Moore (*Transactions of the Medico-Chirurgical Society*, vol. xlvi.), where a stomach, so enlarged as to be capable of containing a gallon and a half, was situated in the sac of an umbilical hernia. There were several sloughs on its inner membrane, and in one spot a perforation had taken place, the size of a sixpence. When a stomach is much dilated, in case no adhesions have been formed between it and some of the neighbouring organs, it is displaced downwards by the weight of its contents. As a result of this, the umbilical region is much distended, whilst the epigastrium is hollow and sunk inwards, so that a distinct prominence can be often discovered, stretching between the lower part of the left hypochondriac region and the other side.

16. **Stomach, Morbid Growths in.**—The stomach is liable to all the forms of morbid growth that are met with in the other structures of the body. Excepting the breast and uterus, no part is so frequently the seat of malignant disease. All the varieties of cancer attack this organ, and not unfrequently they are combined. Thus we meet with scirrhus and encephaloid, or scirrhus and colloid, in the same tumour.

*Scirrhus* is by far the most common, constituting, according to the researches of Dr. Brinton, three-fourths of the whole number. Its most usual seat is the pylorus or the lesser curvature, and here it forms a tumour that rarely invades the duodenum, but tends to surround the organ. When a section is made at an early period of the disease, the distinction between the different coats is readily seen. The peritoneum and the tissue directly beneath it are thickened, the muscular structure is of a grey colour, and much increased in bulk, the bundles of fibres being divided from each other by firm septa of connective tissue. The mucous membrane covering the tumour may appear to the naked eye to be healthy. Sooner or later ulceration takes place, and a deep excavation results, with thickened elevated edges, and with a base not unfrequently covered with fungoid projections. Microscopically the tumour presents the ordinary appearances of scirrhus. The muscular structure is usually in a state of degeneration near the cancerous structure, even when it has not been invaded by the disease. The mucous membrane has been more or less diseased in all the cases the writer has examined, even at a distance from the tumour. The tubes were generally united to each other, and were, in many places, in a state of atrophy or of fatty degeneration.

*Encephaloid* cancer has affected the stomach in about one-tenth of the cases recorded, according to the inquiries of Dr. Brinton. It forms soft, quickly-growing nodules, which project below the peritoneum, or elevate the mucous membrane. It seems generally to commence, as scirrhus does, in the submucous tissue. When ulceration occurs, numerous fungoid masses, which are often very vascular, project upwards. The muscular coat is more completely destroyed in the neighbourhood of the tumour than in scirrhus, and the mucous membrane is generally diseased in all parts of the organ. The tubes are not, however, so much atrophied as in the harder form of cancer, but are usually distended with cells, and the subtubular and intertubular spaces are occupied by cells of various sizes.

*Colloid* cancer is generally associated with scirrhus. The structure feels softer than when scirrhus is present alone, and consists in part of a gelatinous material contained in round or oval spaces bounded by connective tissue. Dr. Brinton calculates that only 9 per cent. of all the cases of cancer of the stomach are composed of colloid uncombined with scirrhus.

*Villous* cancer presents a mass of elongated processes, which, under the microscope, seem to be composed of fibrous tissue loaded with cancer-cells, each usually possessing a loop of blood-vessels. All the villous projections that are found on the mucous membrane of the stomach, are not, however, necessarily malignant, some being of the nature of *fibrous papilloma*. *See* Stomach, Cancer of.

*Lipoma*, *sarcoma*, and *adenoma* are also occasionally met with in the stomach.

*Tubercle* is very rare, and only found where there has been general tuberculosis.

17. **Stomach, Neuroses of.**—The subject of *gastric neuralgia* has been already partially discussed (*see* Gastralgia), and it has been pointed out that it rarely occurs independently of symptoms indicating some disorder of the digestion. The writer has, however, met with it as a periodical affection unattended by any gastric disease. These cases occur chiefly in females of a nervous temperament, are worse at the catamenial periods, and yield to treatment of a tonic character.

*Hyperæsthesia* of the stomach is a very common accompaniment of various gastric disorders. Its presence in a measure accounts for the very great degree of suffering experienced in many cases of ulceration, and it often confers upon a case of atonic dyspepsia an amount of pain that leads the practitioner to suspect his patient is affected with some grave organic disease of the organ. This increased sensibility of the stomach often leads to mistakes in the treatment of gastric ulcer, by inducing us to persevere with liquid diet and opium long after the sore has completely healed. In hyperæsthesia of the stomach iron occupies the most important place as a remedial agent, and may be combined with quinine, strychnine, or other bitters. Arsenic, in doses of three or four minims of Fowler's solution, gradually increased and given directly after food, is often exceedingly useful. The nitrate and oxide of

silver are favourite remedies with many practitioners, but the writer has found them less useful than the tonics before mentioned. As soon as it can be borne, porter or bitter ale will be found beneficial. In the majority of cases change of air and a carefully regulated diet are more efficacious than drugs.

*Spasm.*—Spasm of the stomach is a frequent complaint, and chiefly occurs in females who are subjects of atonic dyspepsia. The attacks mostly occur after a meal of an indigestible character; but in other instances a single mouthful of food, taken after a long fast, may produce it. In the former case the painful spasm probably arises from the stomach becoming overdistended with flatus, which it has been unable to expel, on account of a spasmodic contraction of the cardiac orifice. In the latter the organ is most likely distended by flatus, and the entrance of food excites a contraction which the exhausted muscle is unable fully to execute. During the attack relief may be obtained either by a subcutaneous injection of morphia, or by a draught containing opium combined with chloroform or ether, or with some essential oil, such as mint or cinnamon. The treatment between the attacks must be conducted on the principle laid down for atonic dyspepsia. *See* Stomach, Atony of.

*Paralysis of secretion.*—It now and then occurs that the power of the stomach to secrete appears to become paralysed, just as we occasionally find to be the case with the kidney, and probably with other organs of the body.

*Vomiting.*—One of the most important of the neurotic affections of the stomach is where vomiting is habitually present, without any other signs leading us to suspect disease of the stomach itself. Reference is not made here to the cases where the vomiting accompanies pregnancy, or uterine or brain disease, but where it occurs without any nausea. It chiefly presents itself in hysteria and phthisis, and in the latter disorder is, according to the writer's observation, most frequently met with where the apex of the right lung is chiefly affected. Hysterical vomiting comes on whilst the patient is eating, or almost immediately after the meal is finished. A person will leave the table suddenly, reject what has been taken, and often complain again of hunger. What is vomited is not sour, and seems to consist only of food in the state it had been in just before being swallowed. There is no pain, and although the flesh and strength are reduced, it is not to the extent that might have been expected. In all probability, therefore, only a part of what is taken is returned, for in severe cases the symptom is present whenever an attempt is made to take food. Various methods of treatment have been put in force, and in many cases without any success. Electricity has been strongly recommended, whilst morphia, hydrocyanic acid, aconite, bismuth, oxalate of cerium, nitrate of silver, and innumerable other remedies have been employed. According to the writer's experience the most useful plan is to administer a dose of morphia and solution of potash a few minutes before food. In other cases, he has tried ice for the same purpose. The food should be of a digestible nature, but solids agree better than liquids, although instances are given where the irritability of the stomach has been overcome by small quantities of liquid food given every half-hour. In very obstinate cases all food must be abstained from, and life supported for a few days by nutritive enemata.

Cases occasionally present themselves in which symptoms of disease of the spinal cord follow affections of the stomach. In such cases vomiting has been excessive and frequently recurring; pains, evidently of a neuralgic character, have first attacked the feet and extended upwards; and as the pains have subsided, paralysis has gradually crept on. The treatment found most successful has been the employment of sedatives so long as the pain continued severe, followed by the use of electricity and mineral tonics when the paralysis alone remained. The valerianate of zinc combined with quinine is often very efficacious in restoring the patient to health. In other cases strychnia, quinine, and iron have been employed, either alone or in combination.

18. **Stomach, Perforation of.**—With the exception of a few rare cases where the coats of the stomach have been penetrated by mechanical injuries, or by the extension of disease from some of the neighbouring organs, perforation is the result of simple or cancerous ulceration. In the majority of the cases of ulceration, the peritoneal covering of the stomach inflames as the disease approaches it, and the organ becomes attached to some of the adjoining parts. In this way a barrier is formed against an opening being made into the peritoneal cavity; and, as the ulceration deepens, its base is formed of the structures to which the coats of the stomach adhere. It has been calculated by Dr. Brinton that 70 per cent. of the simple ulcers situated at the posterior surface, are closed in by union with the pancreas or liver. But when this safeguard does not exist, the extension of the ulceration outwards finally reaches the peritoneum, this thin membrane sloughs, and a portion of the contents of the stomach escapes into the peritoneal cavity. Sudden and violent peritonitis is immediately set up, which is almost always followed by fatal consequences. In some cases, instead of the contents escaping from the stomach, a mere leakage occurs through the peritoneum, which is sufficient to produce inflammation of the serous membrane. Hence it may happen that, instead of general peritonitis, circumscribed inflammation is set up by the perforation, and an abscess follows, bounded by the neighbouring organs, which have become closely united to each other and to the stomach. Some cases are recorded, where an abscess thus formed was evacuated through the lungs by perforation of the diaphragm, the pus exciting in its passage gangrenous pneumonia or pneumothorax. The writer has known the gush of pus from the abscess produce sudden death by suffocation; and in a few cases placed on record an external opening has taken place, and a gastric fistula has been established. Occasionally, the stomach adheres to the colon, or even to a coil of the small intestine, and an extension of the ulcer

brings about a communication between these organs. Ulcerations situated in the anterior surface of the stomach are most apt to perforate the peritoneum, as the greater mobility of this region lessens the chance of adhesions taking place. Simple ulcerations are more apt to penetrate the serous sac than those of a cancerous nature, as adhesions are much more apt to occur in the case of the latter. Perforation again takes place more readily in the young than in those of more mature age, and it is especially liable to affect females. More than half the cases amongst females occur between the ages of fourteen and thirty, but in the other sex the effects of age are not so strongly marked.

Symptoms.—In cases of chronic ulcer, the symptoms produced by the perforation are preceded, for a more or less lengthened period, by pain, vomiting, or hæmatemesis. But in young persons the occurrence of perforation often takes place with startling suddenness, and the pain comes on when the patient believes herself to be in perfect health. In most cases careful inquiry shows that there has been previously slight uneasiness after food, flatulence, or other signs of disordered digestion. It is, however, important to recognise the fact, that this terrible accident occasionally occurs where there has been no previous complaint of ill-health, and that any sudden and severe pain in the abdomen in a young person should never be treated lightly. In a large proportion of the cases admitted into a hospital, purgatives or stimulants have been previously given, and it has occasionally happened that castor oil, or some other medicine, has been detected in the peritoneal cavity on examination after death. The first symptom of peritoneal perforation is a sudden and severe pain in the abdomen, and this is not necessarily referred to the region of the stomach. It is quickly followed by retching or vomiting; and when the patient is seen by the practitioner, the symptoms of general peritonitis are present in a marked degree. The patient lies upon his back, with his knees raised, dreading to make the slightest motion, speaking only in a slow and guarded manner, and breathing quickly and carefully, lest the action of the diaphragm and abdominal muscles should increase his suffering. The face is pale, and expressive of pain and anxiety; the whole abdomen tense, and so excessively tender that the slightest pressure is dreaded; the pulse is quick, small, and compressible; the extremities are cold; and the bowels obstinately confined. The patient may either sink in the stage of collapse, or the pulse may recover its strength, the extremities regain their warmth, and death may occur from peritonitis some days later. One well-authenticated case has been recorded where recovery took place; and, on the patient subsequently dying from a fresh perforation, the results of the former penetration of the abdominal cavity were observed. Several cases which are related as recoveries from perforation, have been recorded of late years in the public journals; but the evidence that they really were so seems to be insufficient. When perforation of the colon takes place, the pain is often very severe, from the co-existence of peritonitis; and the sudden appearance of fæces, or of fœtid gas in the vomited matters, indicates the presence of an opening into the large intestine. In other cases, the communication between the organs appears to be of a valvular kind, so that severe diarrhœa may occur from the entrance of the gastric contents into the gut, without any appearance of fæculent matters in the fluid rejected from the stomach. Where perforation of the diaphragm has occurred, there has usually been severe febrile action, with great pain in the side or epigastrium, followed, after an interval of some time, by the symptoms and physical signs of pneumothorax or gangrenous pneumonia.

Diagnosis.—Peritoneal perforation is most apt to be confounded with colic, or the passage of a biliary or renal calculus. In all these cases there is the occurrence of sudden and severe excruciating pain of the abdomen, often attended by vomiting, and all may be accompanied with great depression. In perforation, however, the patient lies in the recumbent position, with the legs drawn up; whilst in the passage of calculi or colic he is restless and tosses about. In the former, the pulse is rapid, and there is intense abdominal tenderness; in the latter the patient often seeks, by pressure over the seat of the pain, to relieve his suffering, and the pulse is but little quickened. In perforation, there is often a history of symptoms indicating gastric ulcer; in colic, not infrequently, an account of previous attacks of a similar description.

Treatment.— The only chance the patient has of escape from death is in the most perfect rest, both of the whole body and of the digestive canal. Food and drink of every kind must be forbidden, and even enemata should be avoided. A full dose of opium must be administered, as much as 2 grains, and a smaller quantity repeated every three or four hours subsequently. Cold applications externally have been recommended, but it will be generally found that warm fomentations give more relief. If improvement take place, it will be better to support the strength of the patient for some time by nutrient enemata, than by food given by the mouth.

19. **Stomach, Softening of.**—There are few stomachs examined after death, more especially during the warmer months of the year, that do not show some signs of softening. When this change is only slight, the surfaces of the rugæ alone seem softened, and have a semitransparent appearance. When it is more extensive, the whole of the lining membrane covering the fundus has a smooth, thin, translucent appearance, and is either readily detached by the finger, or forms a slimy mucus overlying the subjacent coats. Where the process has proceeded still farther, the muscular and peritoneal layers are soft and pulpy; and occasionally the organ is perforated, and the contents are found in the cavity of the peritoneum. More rarely still, the softening affects the neighbouring organs, the œsophagus or diaphragm being perforated; and the gastric contents may be found in the left pleura. The nature of this process has given rise to no small discussion. John Hunter, who first remarked its occurrence in healthy persons who had been

killed by accidents, attributed it to the action of the gastric fluid upon the stomach after death. Some pathologists of eminence, whilst admitting that softening may result from *post-mortem* solution, contend that certain forms of this condition occur during life, and differ in their character from cadaveric changes. Rokitanski distinguishes two primary forms of softening: one a disease of infant life, called *gelatinous* softening, in which the whole fundus is converted into a greyish, transparent jelly, and which is usually an accompaniment of brain-affections. The other, in which the parietes of the stomach are converted into a dark-brown pulp, occurs either in brain-diseases, or as a sequela of typhus, pyæmia, acute tuberculosis, acute cancer, and other diseases. One chief cause of difference in the appearances of these forms is the state of the blood-vessels. In the first the pallor arises from the anæmic condition of the lining membrane; whilst in the latter the dark-brown colour is probably dependent on the action of the acid upon the blood contained in the distended veins and capillaries. Notwithstanding the authority of the distinguished pathologist just named, it is generally believed at the present day that all the various forms of softening are merely the result of *post-mortem* digestion, and that the differences in appearance between them are but the effects of the varying amount of acid that may exist in the stomach at the time of death.

Certain circumstances have been found to favour the occurrence of *post-mortem* softening of the stomach:—1. The condition of the atmosphere at the time of death is one element. It was in summer that the cases occurred that first attracted the attention of Hunter, and it is found that the extent of softening which occurs in cold weather is comparatively trifling to what is observed in the warmer months of the year. This is what might have been anticipated, for we know that heat is requisite in order that artificial digestion should proceed quickly. 2. The amount of the contents of the stomach exercises a considerable influence. When death has occurred whilst the stomach is empty, little or no softening occurs, but if it contain food the mucous membrane is sure to present some indications of change. 3. The nature of the contents of the stomach is still more important in determining the amount of softening. It is well known that the presence of an acid in the gastric juice is requisite for the performance of digestion, and we consequently find that there is the greatest extent of change where there is a large amount of acid in the contents of the stomach at the time of death. This fact has been ingeniously used to explain why the *post-mortem* changes are so extensive, as remarked by Rokitanski, in brain-disease and in the case of children. It is believed that an unusual amount of acid is secreted in cerebral affections, as we know is the case in certain irritations of the liver and kidney; and as the food of children is mostly composed of milk, it is assumed that the lactic acid resulting from its decomposition, united with the pepsin contained in the stomach, forms a digestive fluid possessing great activity. 4. The condition of the stomach as regards the amount of pepsin stored up in it exercises a considerable influence upon the chance of its softening. It has been elsewhere shown that in typhoid fever, chronic atrophy, and chronic hyperæmia, the amount of pepsin stored up in the gastric mucous membrane is very small, and it is in these disorders that we meet with very little alteration in the organ after death. 5. Another point, which has not attracted sufficient notice, is that the texture of the organ varies in different cases, and that some more readily yield to the solvent action of the gastric juice than others. To prove this the writer placed in an artificial digestive fluid equal portions of three human stomachs. The first was normal; the second in a state of fatty degeneration; whilst, in the third, the tubes were replaced by fibrous tissue, and the blood-vessels were much congested. After a few hours' digestion the first piece was found reduced to a pulp; the second was gelatinous, and of a yellow colour; the third formed a black, opaque mass, quite unlike the others. Here, it will be observed, the colour and appearance of the different specimens varied; and in many cases, as for example in children, the softness of their healthy mucous membrane greatly determines the rapidity and completeness with which the gastric fluid acts upon it. To ascertain if this was correct the writer placed in some artificial gastric fluid four pieces of stomach. The first was taken from a healthy dog and was soft; the second from a healthy human subject; the third and fourth from females who had died from cancer of the breast, and the mucous membranes of whose stomachs were extensively atrophied. After three hours' digestion at 100°, the first broke up into fragments; the second was reduced to a pulp; whilst the third and fourth showed only a little softening on their surfaces, but were in other respects unaltered. The completeness with which the first two were dissolved was found, from other experiments, to have partly arisen from the acid being imbibed by the tissue, and coming into contact with the pepsin stored up in the gastric cells, which were absent in the diseased structures of the third and fourth specimens. But the question arises, whether softening of the mucous membrane of the stomach ever occurs without *post-mortem* solution? This must be answered in the affirmative. During the continuance of the cattle-plague the animals affected were killed, and in some cases the stomachs were immediately removed and brought to the writer. In each case the mucous membrane was very soft, and presented, under the microscope, the usual appearances of gastritis. Again, in certain disorders—as, for example, in cancer of the uterus—the writer has always found the gastric mucous membrane very soft, where there was no appearance of cadaveric change. This softness probably arises from imperfect nutrition, and is analogous to the fatty heart so commonly met with in such cases. Fatty degenerations of the stomach are by no means uncommon—for instance, the whole membrane has been found in this state in a case of gastric ulcer; and we can scarcely suppose that an organ in such a condition can have the same firmness as when the glandular texture is in a perfectly healthy state.

20. **Stomach, Ulcer of.**—ÆTIOLOGY.—The age of the individual is allowed by all observers

to be one of the chief predisposing causes of gastric ulcer. Where the functions of the stomach are most actively performed, as in childhood, it is scarcely ever met with, Dr. Brinton having been only able to find two cases out of 226 in children below ten years of age. It becomes gradually more frequent as age advances. Females are more liable to the disease than males, in the proportion of three to one. The chief preponderance of liability amongst females occurs at the commencement and the cessation of the catamenia. In both sexes, want of food, mental anxiety, and other depressing conditions, have been referred to as tending to produce the disease in question. Many authors regard intemperance as one of the most potent causes. Although the writer has certainly seen the symptoms of gastric ulcer follow a too free use of alcohol, yet he has been greatly surprised to find how rarely the stomach has presented any signs of disease, beyond those of catarrhal gastritis, in a considerable number of persons who had died of delirium tremens. Some have affirmed that tuberculosis is a common predisposing cause, whilst Dr. Brinton has remarked that persons affected with phthisis are not more liable to gastric ulcer than other persons. The writer has found the ordinary ulcer rare in such cases, but superficial ulcers near the pylorus are by no means infrequent, and are probably the result of the acute erythematous gastritis, to which attention has been directed, as tending to complicate the later stages of pulmonary disease (*see* Stomach, Inflammation of). If we sum up the chief causes, we find the conclusions confirmed to which morbid anatomy directs us. Advanced age, which gives rise to fatty and fibroid degenerations, both of the tissues and the blood-vessels, is the chief predisposing influence of gastric ulcer. In like manner, syphilis and tubercular affections, which lead to ulcerations of the skin, by diminishing the reparative powers of the system, seem also to induce gastric ulceration. In addition to these all conditions that lead to chronic catarrhal gastritis, such as uterine affections, and diseases of the heart and liver, have also a decided tendency to set up the disease.

Anatomical Characters and Pathology.—Ulcerations in this organ are of frequent occurrence, being present, according to the researches of Dr. Brinton, in about 5 per cent. of the deaths arising from all causes. The ulcers are usually round or oval, varying in size, as a general rule, from the diameter of a fourpenny-piece to that of a half-crown. They have been found to destroy life when so small that the most careful search was necessary to ascertain their existence, and, on the other hand, they may be met with many inches in diameter. When of recent formation, the edges are sharp, and the sore looks as if a portion of the mucous membrane had been punched out; but when it has lasted for some time, the edges are hard, callous, and adhere to the subjacent tissue. The diameter of the ulcer usually lessens from above downwards; so that in case the peritoneum has given way, the perforation may be a mere chink. The base of the ulcer may be formed either of the muscular coat or peritoneum, or of some of the neighbouring organs—such as the pancreas, liver, or spleen—which have become attached to the stomach by adhesions. Microscopically, in recent cases the writer has generally found the tubes around the ulcer healthy, with the exception that a few blood-globules are extravasated amongst them. In older cases, the surrounding tissues are matted together, and the tubes are compressed and atrophied, whilst the newly-formed fibrous tissue closely unites the edges of the lesion to the parts below and around them. But the mischief is always confined to the neighbourhood of the ulcer, and we never discover a general atrophy of the secreting structures of the stomach, as in malignant disease. At the most, the mucous membrane presents the signs of fatty degeneration, or the usual appearances of acute or chronic catarrhal gastritis. Where the ulceration is spreading, the tubes immediately around it may be seen to be more or less emptied of their secreting cells, whilst their basement membranes have fallen together. Still further off may be remarked tubes only partially filled with cells, and the mucous membrane is consequently thin and soft.

Gastric ulcers are most common in the pyloric region, being chiefly situated on the posterior surface, and near the smaller curvature. When two are present, it is not unusual to find them opposed to each other, as though they had been both produced by the same irritation. When an ulcer exists in the duodenum, it is very common to find one also in the stomach.

There has been much difference of opinion as to the method by which gastric ulcers are produced. Some authors are fond of pointing out that sores of this character are confined to the stomach and duodenum, where an acid secretion comes in contact with the tissues; whilst in the remaining parts of the small intestine they are rarely discovered. Hence it has been assumed that they are dependent, in some way or another, upon the solvent action of the gastric juice. But it should be remembered that the ulcerations are very rare where the power of secretion is most active, and where it remains longest in contact with the mucous membrane—namely, at the fundus; and also, that they are extremely uncommon in childhood, when the gastric functions are most energetically performed. Instead, therefore, of the presence of the gastric juice being the cause of the stomach being so especially liable to ulceration, may not the rarity of ulcerations in the small intestines be rather due to the greater development of the lymphatic system in them, which obviates the ill-effects of any temporary congestion, and to the fluid nature of the contents of this portion of the canal? We have not here space to discuss the various hypotheses that have been invented to account for the production of gastric ulcers; but we may fairly allow that, like ulcerations on the exterior of the body, they must originate from very different causes.

1. They may be produced by the sloughing of portions of the mucous membrane arising from general debility. Such cases have been discovered in persons broken down by syphilitic disease, kidney-affections, and other exhausting maladies. We see analogous cases of sloughing

of the mucous membrane of the oral cavity in a similar state of health.

2. The death of small portions of the mucous membrane has been attributed to embolism of the arteries of the stomach. Against this, as a common cause, is the fact that the gastric ulcer is generally single, and that we constantly fail to discover ulcerations where numerous emboli can be proved in the vessels of the other principal organs of the body. It is probable, however, that some rare cases are to be attributed to this cause.

3. The perforating ulcers so commonly met with in young persons were attributed by Rokitanski to hæmorrhagic erosions of the mucous membrane, produced by catarrh. His opinion seems to be supported by the fact, that these ulcers are most frequently present where catarrh is most common, namely at the pyloric region; and also that their occurrence is usually preceded only by symptoms indicating a slight attack of catarrhal gastritis.

4. Dr. Copland pointed out how often the arteries of the stomach were diseased, where an ulcer was present, especially in old people. The truth of this remark the writer can confirm, from the microscopic examination of a number of specimens; and to this circumstance we must also attribute much of the difficulty experienced in the cicatrization of gastric ulcers. Where the arteries are healthy, it will be often found that the veins are thickened and tortuous, and it need not be pointed out that the effect of a similar condition is daily seen in the production of ulcerations of the lower extremities.

5. Probably not less powerful in setting up these ulcers in the aged are the fatty and fibroid degenerations of the mucous membrane, so often discovered on microscopical examination. It seems reasonable to suppose that in tissues thus altered, a slight irritation would be sufficient to set up an ulcerative process.

When a small and superficial ulcer of the stomach heals, only a slight scar is left; but where it has been of large size, and has penetrated more deeply, the organ may be puckered up by the cicatrix, and considerable change of shape may be produced. The ulceration may, on the other hand, produce death by laying open a blood-vessel; by perforating the peritoneum or some of the neighbouring organs; or, in more rare cases, by giving rise to abscess of the liver.

Symptoms.—Pain is by far the most constant and prominent symptom of ulcer of the stomach. At first, it is only a feeling of uneasiness after food, but as time goes on it increases in constancy and severity. It commences shortly after food, and persists during the whole period of digestion, or until the contents of the stomach are rejected by vomiting. In some cases it begins as soon as food has been taken, but more generally an interval of fifteen or twenty minutes elapses before it is complained of. The pain is usually relieved by the recumbent position, but in some the patient finds relief by bending the body over a chair or by lying on one side. The writer has seen cases of large ulcers, in which there was little or no pain, the sore being apparently insensible to irritation, as is sometimes seen to be the case in old ulcers of the legs. The pain is referred to one spot, which is usually situated in the epigastrium, but more rarely it affects the left hypochondrium or the umbilical region. In a considerable number pain is experienced in the back, usually at a place between the last dorsal and the first lumbar vertebræ, or rather a little to the left side of this region. It is not uncommon for the pain to increase for a few days, and then gradually to subside. These exacerbations the writer has chiefly observed in very chronic cases. They probably point to an extension of the ulceration, for they not infrequently precede hæmorrhage and perforation. In almost every case we meet with tenderness on pressure over the seat of the sore. This may be so great that the patient is unable to wear his clothes moderately tight; in others it requires a careful search to discover the sore spot. The tender part is, as a rule, opposite the place to which the pain is referred, and can often be covered by the finger-end. General tenderness is no test of an ulcer, as it is often present in congested liver, gastric catarrh, and other complaints of the epigastric region. It is necessary to be careful in testing for the existence of a gastric ulcer by the finger, for a very slight pressure often suffices to bring on a paroxysm of pain, even when the stomach is empty of food. The tender spot may be situated in the epigastrium, in the hypochondrium, or near the umbilicus, but it is most generally in the first-mentioned locality.

Vomiting, although often present, is a much more variable symptom. It seldom occurs directly after food, as is often the case in cancer, because the cardiac orifice is rarely the seat of simple ulcer. It is preceded by nausea, not infrequently by a copious flow of saliva, and it relieves the pain by freeing the stomach of its acrid contents. The tongue may be perfectly clean, or may be thickly coated. As the abnormal appearances of the tongue in dyspepsia arise from an extension of gastric catarrh to the mucous membrane of the mouth, a perfectly clean tongue is present, if the ulcer is unattended by gastritis. Flatulence is not a common symptom, inasmuch as the amount of food taken is limited, on account of the pain produced by it. Extreme acidity occasionally presents itself, but it is not so common as the statements of some authors would lead us to imagine. The appetite is seldom much affected, especially in the young. Patients often remark that they could and would eat freely, were it not for the dread of the pain. The bowels are generally confined. The stools are knotty, and in many cases contain mucus. There is nothing characteristic about the urine. It is usually clear, and is passed frequently, and in unusually large quantities. Whenever the disease has lasted for some time there is a loss of strength and energy, arising from imperfect nutrition, from the frequent attacks of pain, and from the vomiting. The duration of gastric ulcer varies greatly. In some cases the sore seems to heal rapidly; whilst in others the symptoms often subside and reappear, so that the patient remains an invalid for years. Chronic cases in old people are often very difficult to cure, and great patience and perseverance are required in order to obtain even

an alleviation of the symptoms. The symptoms produced by hæmorrhage and perforation are elsewhere described. *See* HÆMATEMESIS; and Stomach, Perforation of.

*Physical Signs.*—In a recent case of gastric ulcer we can expect no assistance from physical signs, but where the disease has lasted for some time evidence of adhesions may be detected. Adhesions may be suspected, when it is found, by auscultation and auscultatory percussion, that only a small portion of the stomach is in apposition with the abdominal walls, and more especially if this part is the tender spot, and does not vary its position with different states of distension of the organ. Again, if the stomach is found to be of considerable size when empty, and its extent not increased by food, we may suspect that its motions are trammeled by adhesions. The microscope affords but little assistance in the detection of gastric ulcer, because the extension of this disease is usually very slow, and we therefore have little chance of discovering portions of the mucous membrane in the vomited matters.

TREATMENT.—The main indication, where the symptoms of ulcer of the stomach are urgent, is to give to the affected organ as perfect a state of rest as is possible. The patient must be placed in the recumbent position, unless it produce pain, and must retain it strictly. In the more chronic cases, or when the more severe symptoms have subsided, a limited amount of exercise may be permitted, lest the general health become deteriorated by confinement. In urgent cases mere position is not enough, and physiological rest must be insured. It is, therefore, often necessary to interdict the use of all food, and to keep up the nutrition of the body by nutritive enemata. In less severe cases it is only necessary to confine the patient to liquid food, taken in small quantities and frequently. Milk must form the basis of diet, and it can be either taken alone, or, if there be much acidity, mixed with lime-water or with Seltzer or Vichy water. In some cases buttermilk agrees, where sweet milk produces vomiting. In others the concentrated Swiss milk is more readily digested. But sometimes milk in all forms disagrees, unless it be mixed with some farinaceous material, such as arrowroot, sago, tapioca, or corn-flour. As the patient improves a more nutritious diet may be prescribed, such as beef tea, mutton broth, chicken broth, eggs, maccaroni, or light puddings. Where the patient is young and otherwise healthy, leeches are often of great service. Some practitioners have objected to their use, but the writer has often seen them of signal benefit. It is seldom necessary to apply more than six at a time, and they may be repeated from time to time, as the case requires. In others dry-cupping answers a good purpose. Where there is reason to object to the effects of the leeches, a bladder filled with ice and applied to the part often affords relief; but, in general, hot poultices and fomentations are more useful. In long-standing cases great benefit is often derived from repeated small blisters, or from the application to the epigastrium of tartar-emetic ointment or croton oil. The most valuable remedy in all cases is opium. It relieves pain, controls the action of the muscular coat, and restrains the secretion of the stomach. It is best given in doses of one or two grains, once or twice a day, shortly before food. It is a common practice to apply morphia hypodermically, but this in some cases produces vomiting, and must, therefore, be used cautiously. Besides this, it must be remembered that the sedative, when taken by the mouth, is more directly applied to the ulcerated and tender surface. The vomiting is a most distressing symptom, and tends to prevent the healing of the sore. The fluids rejected should be often examined by the microscope. If torulæ or sarcinæ are present, recourse must be had to carbolic acid, creasote, or sulphurous acid; at the same time a small blister should be applied to the epigastrium. When a large quantity of mucus is discharged, the case is best treated with full doses of bismuth, magnesia, and morphia, or with oxalate of cerium. As soon as the more active symptoms subside, it is necessary to administer tonics. Some preparation of iron may be selected; the saccharo-carbonate or citrate answers the purpose best.

When the case is still more chronic, preparations of silver, copper, and zinc have been recommended. The nitrate of silver is, in the opinion of most authors, to be preferred, whilst others have looked upon it as inert in the doses usually given. The writer has certainly seen great benefit from both it and the sulphate of copper; but, on the other hand, he has seen mischief result from the administration of these salts at too early a period. As the bowels are almost always confined in gastric ulcer, it is necessary to promote their action by castor oil, small doses of aloes, or enemata. In the more acute stage of the disease all irritating aperients must be, of course, carefully avoided, and the bowels should be relieved only by injections.

**21. Stomach, Vessels of, Diseases of.**—The blood-vessels of the stomach are frequently diseased, and their morbid conditions no doubt play an important part in the production of anatomical changes in the other structures of the organ. Dr. Copland, many years ago, drew attention to an atheromatous state of the arteries as frequently present along with gastric ulcer, and the same remark has since been made by Virchow. From repeated examinations of cases of chronic gastric ulcer with the microscope, the writer can confirm the truth of these statements. He has constantly found the arteries thickened and enlarged in the neighbourhood of the ulcer. Not unfrequently the vessels, as well as the other textures of the organ, are in a state of fatty degeneration, the condition being in some degree analogous to what is observed in fatty degeneration of the heart, in connexion with obstruction of the coronary arteries. Where the arteries are healthy in gastric ulcer, the veins of the mucous membrane are generally thickened and dilated, displaying a state like that so constantly remarked in the veins of the lower extremities where ulcers have been long existing. In cancer of the stomach the smaller arteries in the neighbourhood of the malignant growth have been often found greatly thickened. This condition

seems to be an important one in determining the future progress of the malignant growth, as leading to its being imperfectly supplied with blood, and its consequent sloughing. But an abnormal state of the smaller arteries of the stomach is also met with where there is no other disease. There has been much dispute whether a similarly thickened condition of the arteries in contracted kidney is a result, or merely a co-existing state, of other morbid changes. The occurrence of thickened arteries in the stomach without, as well as with, other structural alterations, seems to show the opinion of those to be correct who hold that the arterial changes in atrophy of the kidney are not necessarily the result of the other abnormal states. Affections of the veins of the mucous membrane of the stomach are constantly present in heart-disease, and in cirrhosis of the liver. In such complaints we usually find the vessels much dilated and the coats thickened. SAMUEL FENWICK.

**STOMACHICS** (*στόμαχος*, the stomach). SYNON.: Fr. *Stomachiques*; Ger. *Magenmittel.*

DEFINITION.—Substances which increase the functional activity of the stomach.

ENUMERATION.—The most important stomachics are Alcohol, Acids, Alkalies, Aromatics, Bitters, Arsenic, Pepsin, and Strychnia or Nux Vomica.

ACTION.—In the act of digestion the stomach has the threefold function of secretion, movement, and absorption. By an abundant secretion of gastric juice some of the albuminous constituents of the food are quickly digested; and this digestion is aided by the movements of the stomach, which mingle the gastric juice with the food, and aid solution by breaking up the particles. From the stomach, also, absorption of some of the products of digestion goes on. Some stomachics, such as alcohol and dilute alkalies, increase the secretion of gastric juice; possibly also bitters, and small doses of arsenic. Dilute acids, given after meals, and pepsin supply the essentials of gastric juice when secretion is deficient. It is not improbable that the peristaltic movements of the stomach are increased by strychnia and nux vomica. We want experiments on the action of drugs which increase absorption. It is also probable that some of the good results of bitters are due to their preventing abnormal processes of fermentation in the stomach. T. LAUDER BRUNTON.

**STOMATITIS** (*στόμα*, the mouth).—SYNON.: Fr. *Stomatite*; Ger. *Mundschleimhautentzündung.*

DEFINITION.—Inflammation of the mouth.

VARIETIES.—Stomatitis is chiefly met with in infants and young children. It presents itself under three varieties:—1. *Follicular*; 2. *Ulcerative*; and 3. *Gangrenous.*

1. **Follicular Stomatitis.**—This form of inflammation of the mouth is very apt to arise when children are recovering from the eruptive fevers. But it may also be met with in comparatively strong children, both in connection with severe dental irritation, and also originating in a true herpes of the mouth, analogous to, and sometimes associated with, *herpes labialis.*



Follicular stomatitis has its origin in the follicles of the mucous membrane, which become inflamed, and exhibit spots of white exudation. There is, however, no breach of surface. The name of *aphthæ* is often, though incorrectly, given to simple, or follicular, stomatitis; and the term *thrush* is popularly applied to both complaints (*see* APHTHÆ; and THRUSH.) Follicular stomatitis is not a serious complaint, though it indicates a weak state of health and a faulty nutrition. The little patient swallows with difficulty. There is an increased flow of saliva; the mouth is hot and tender; the sub-maxillary glands are swollen; and the bowels are disordered.

2. **Ulcerative Stomatitis.**—This is merely an advanced form of the preceding variety. The inflamed follicles break and form small ulcers, covered with a greyish or yellowish slough. These ulcers may remain separate and distinct, or several may coalesce to form one larger ulcer. Sometimes the ulcerative process spreads rapidly. This is especially apt to be the case when the disease is situated on the gums. In a severe case the bases of the teeth and the alveoli may be exposed.

TREATMENT.—The treatment of these two varieties of stomatitis must be conducted on the same principles, and may, therefore, be given under the same head. It is necessary to put the child in a favourable hygienic condition, and to regulate its diet. If it be at the breast, inquiry should be made as to whether it is fed regularly, and only at proper intervals. This should be insisted upon. If the milk evidently disagree, the infant must be weaned. In some cases, however, it may be enough to supplement the mother's milk with some suitable food. With older children attention must be directed to the nutritious quality of their food, and to the regularity of their meals. If it be possible for the child to have a change of air, this alone will often have a most beneficial effect. Small doses of grey powder, or of rhubarb and magnesia, should be given to regulate the bowels; while at the same time chlorate of potash and bark should be prescribed. Subsequently a course of cod-liver oil, or of the syrup of the iodide of iron, or of Parrish's chemical food, will be useful.

Locally, the mouth should be washed with some simple detergent. Borax is the most valuable; but when, as not unfrequently happens, there is some fœtor of the breath, a little tincture of myrrh, or Condy's fluid, may be used with advantage.

3. **Gangrenous Stomatitis.**—SYNON.: *Cancrum oris*; *Noma.*—Occasionally, but very rarely, we meet with a much more formidable variety of stomatitis, arising out of the ulcerative form, and supervening upon measles, or some other debilitating blood-disease. In *cancrum oris* one cheek, generally near the angle of the mouth, becomes swollen, red, brawny, and shining. The whole thickness of the cheek is affected by an acute inflammation, which runs on rapidly to gangrene. The internal surface is the seat of a deep foul ulcer, and the little patient can hardly open his mouth. Gradually the redness passes into lividity; and a black point appears, which is soon the centre of a large slough. When this separates,

the teeth and the interior of the mouth are exposed to view.

Treatment.—Everything must be done to support the patient's strength by milk, beef-tea, wine, and stimulant medicines. The mouth should be syringed frequently with warm water, or with a disinfectant mouth-wash. The cheek must be covered with a poultice or a fomentation until the slough separates, and then the raw surfaces must be dressed with a stimulating lotion —for example, of carbolic or nitric acid, or of sulphate of zinc. If the gangrenous inflammation threaten to spread, the edges must be thoroughly touched with strong nitric acid. Indeed some consider it well to treat the ulcer inside the cheek in this manner from the commencement. In order to do this effectually it will be necessary to administer an anæsthetic. But, in spite of all that can be done, gangrenous stomatitis is a very fatal disease.

W. Fairlie Clarke.

**STONE.**—A popular name for calculus. *See* Calculus.

**STOOLS, Characters of.**—The physical, chemical, and microscopical examination of evacuations from the bowels, or 'stools,' have been fully considered in the article Fæces. There remain to be described here certain characters which the stools possess in special diseases. Owing to the extreme variety in appearance, quantity, consistency, colour, and composition which healthy motions present, their characteristics in disease are of doubtful significance, and it is but rarely that a diagnosis depends on their investigation, unless it be for the discovery of such bodies as entozoa, gall-stones, pins, or other objects accidentally swallowed, and occasionally pus or blood.

In a few diseases only do the evacuations present features of sufficient constancy to be in any way distinctive, and even then it is rather as an element in the diagnosis, than as being actually pathognomonic, that they are to be considered. As might be expected, these maladies are amongst those in which there exists some serious lesion of the gastro-intestinal tract, or of its tributary glands. The following may be referred to in this category:—

**Cholera.**—During the stages of the onset, crisis, and reaction of Asiatic cholera, the stools present a successive series of changes in colour, consistency, and composition. During the preliminary diarrhœa the contents of the bowel are voided in a semi-formed, pappy, and increasingly fluid condition, with a progressive alteration in colour from the normal tint to almost colourlessness. During the algid stage about 50 to 100 ounces are discharged, in 10 to 20 portions, of a rice-water or whey-like appearance, inodorous, and wholly wanting in bile-pigment. The excreta on standing deposit whitish flocculi, consisting of epithelium, fungi, granular débris, and crystals of salts, chiefly phosphates; occasionally a few blood-corpuscles are seen. The supernatant fluid is alkaline; and it contains a large proportion of chloride of sodium, and a little albumen. When the stage of reaction sets in, the stools become coloured, at first greenish, and they then generally assume the normal colour and consistency as the diarrhœa becomes less profuse. In this stage they are sometimes very fetid.

**Dysentery.**—In this disease, more than in any other, are the stools diagnostic, especially if with their appearance their odour be taken into account, as they are peculiarly fetid, or even gangrenous. The frequency of the stools is very great, amounting sometimes to hundreds in the day, but a few drachms being voided on each occasion. Considerable variation is met with, dependent on the severity, type, or stage of the case; but the first discharges, and perhaps the only ones in mild cases, consist of pale yellow masses of glairy mucus, often specked with blood, and with or without a small quantity of pale, feculent matter. The microscope reveals a few leucocytes and free nuclei, with blood-corpuscles, enclosed within the structureless mucus. In later stages, when there is suppuration of the mucous membrane, small red lumps, of an appearance like raw washed meat, are seen in yellowish or reddish albuminous fluid. These masses consist of red blood-corpuscles, imbedded in a stroma of viscid mucus, with pus and epithelial cells and granular débris. Sometimes the stools consist chiefly of blood; at other times pus predominates; and when the disease is of a very malignant character, large gangrenous portions of the bowel are voided with a brownish serous fluid. The mucus is sometimes expelled in a form resembling masses of boiled sago. It is said that a partial diagnosis of the extent of the disease may be made by a study of the characters of the stools.

**Enteric fever.**—Previous to the establishment of the intestinal ulceration in typhoid fever, the stools consist of brownish masses, more or less formed; but subsequently what is often regarded as a characteristic appearance is presented, namely, pale yellow semi-fluid pea-soupy evacuations, of an alkaline reaction, and offensive odour. On standing, the motions deposit a yellow flocculent sediment of particles of food, granular *débris*, fungi, epithelial cells, and crystals of triple phosphates. The fluid has a sp. gr. of 1015; and contains 4 per cent. solids, chiefly albumen and chloride of sodium. Not infrequently blood is found, and sometimes portions of Peyer's patches that have sloughed off. The diagnosis between typhoid and tubercular ulceration of the bowels is not to be made with any certainty from the appearance of the stools. For although the above description applies to the evacuations in many cases of enteric fever, in others they are much more consistent, and even clayey. Identical discharges are met with in tubercular disease of the intestines.

**Pancreatic disease.**—In those morbid conditions where the pancreatic juice is not secreted, from destruction of the gland, as in cancer, or when the secretion is prevented gaining entrance into the bowel from occlusion of the duct, it has long been known that the stools are liable to contain fat in variable quantity, occurring in the form of loose drops, or lumps, or smeared over the fæces, or discharged free from feculent matter, constituting a steatorrhœa. This condition is much more likely to be met with when the bile is prevented from flowing into the duodenum,

although the existence of such obstruction is not a necessity. And further, it must be admitted that fat has been found wanting in the stools when there has been marked pancreatic disease. It must not be forgotten that healthy evacuations contain a small quantity of fat, which may be considerably increased if the amount ingested be excessive. Hence fat in the stools cannot be regarded as absolutely indicative of disease of the pancreas, though very often associated with it. Owing to the frequent association of diabetes with disease of the pancreas, such as cancer or atrophy, fatty stools are often met with in that disease.

**Hepatic disease.**–It is only in affections of the liver in which there exists some interference with the flow of bile into the intestine, that the stools present a characteristic appearance, namely, a want of colour, varying from a pale yellow to a whitish-clay tint, in proportion to the degree of exclusion of the bile. Such evacuations are almost always unformed and of 'porridge-like' consistency; rarely in the form of pale scybala. From want of bile their odour is invariably offensive; and they may be even putrid in cancer of the liver. Since hæmorrhage from the mucous surface frequently complicates icterus, the fæces are sometimes blackened from blood. In a few recorded cases of hepatic disease, where the pancreas has been unaffected, fat has been found in the stools, sometimes in large quantities.

**Fever.**–In the general febrile state, when there is no primary affection of the digestive organs, the motions are diminished in quantity, and as a rule drier, though very frequently unformed. The colour is generally darker, due probably to the increased destruction of blood-corpuscles, and increased elimination of bile-pigment; and the odour is more offensive than in health.

**Other diseases.**—In other affections of the chylopoietic viscera the characters of the alvine discharges are so variable in quantity, colour, consistency, odour, and composition, that no general remarks can be made and no diagnostic indications recorded. Sometimes in grave diseases the motions are not to be distinguished from those in health, whilst a trifling change in diet or habitation, or a slight catarrh, may be accompanied by the discharge of fæces differing in many respects from the normal. The fact is that no standard can be taken, so numerous and frequent are the disturbing causes.

Severe constitutional diseases of a chronic character, as rickets and scrofula, where the general nutrition is seriously affected, and the blood much altered in quality, are very frequently characterised by stools which are pale in colour and fetid in odour. The deteriorated quality of the intestinal secretions, and consequent imperfect digestion of the contents of the bowel, will account for this.

The significance of blood in the motions has been explained in the article Melæna.

Pus in any considerable quantity, and especially if free from admixture with fæces, may be taken to indicate the rupture into the bowel of an abscess, since the inflammatory conditions of the canal, such as enteritis and dysentery, are not accompanied with very extensive pus-production. The contents of pericæcal or perirectal abscesses are usually extremely ill-smelling. *See also* Nothnagel, *Zeits. f. Klin. Med.*, iii., p. 241. W. H. Allchin.



**STRABISMUS.** — Synon. : Squint; Fr. *Strabisme*; Ger. *Strabismus*; *Schielen*.

Definition.—A condition in which the two eyes are not directed to the same point in space.

Description.—Squint is commonly either (1) *convergent*, or (2) *divergent*; but (3) there may be a deviation either *upwards* or *downwards*. When one eye appears to be normally directed, and the other to deviate, it is convenient to distinguish the former as the *working*, and the latter as the *squinting* eye.

The extent or degree of strabismus, or, as it is more usually called, the *magnitude* of a squint, is expressed in terms of millimètres. In convergent or divergent squint it is customary to measure the distance between an imaginary vertical line bisecting the palpebral fissure, and another imaginary vertical line bisecting the pupil of the deviating eye. In an upward or downward squint, the distance between the horizontal diameter of the pupil, and an imaginary horizontal line bisecting the palpebral fissure, would give the measurement required.

1. **Convergent strabismus.**—This is seen under two principal forms; (*a*) that which depends upon *paralysis* or paresis of one of the external recti muscles, permitting the antagonist internal rectus to exert a preponderating influence upon the position of the eye; and that which depends upon *excessive development* of both interni, in consequence of an error of refraction, whether (*b*) *hypermetropia*, or (*c*) *myopia*.

(*a*) *Paralytic convergent strabismus.*—This form of strabismus is met with in all degrees, from the slightest weakening of the affected external rectus to complete paralysis.

Ætiology.—Paralytic convergent strabismus is primarily a nerve-affection, in which, however, the muscle concerned will after a time be liable to undergo degenerative changes. The strabismus usually commences somewhat suddenly, in persons of adult age, and often rapidly increases in degree; the paralysis, which at first was only partial, becoming complete. In the great majority of cases it is associated with syphilis; but it is also met with as a result of impaired nutrition or degenerative change in the nervous centres, consequent upon anxiety or overwork. In some of the syphilitic cases, it appears to be due to central mischief, such as gumma or arterial occlusion; in others to pressure upon the trunk of the sixth nerve by periosteal thickening or other morbid growth.

Diagnosis.—In pronounced cases, the diagnosis is easy; and depends upon the fact that, even when the working eye is closed or covered, the squinting eye cannot be directed outwards by voluntary effort. If the paralysis, although considerable in degree, is not complete, the eye cannot be directed outwards as far as usual; if the paralysis is complete, the pupil cannot be carried external to the middle line of the palpebral fissure. When the affected muscle is only slightly weakened, the nature of the condition may not be at once apparent from the limitation of movement; and the degree of deviation may

be so slight that it is not easy immediately to pronounce which eye is affected. This doubt may be removed, and the existence of paresis made manifest, by the following tests. The surgeon should stand in front of the seated patient, and should hold up before him, in the middle line, and at a convenient reading distance, some small object, telling him to look at it steadily. By his own hand, or by a piece of ground glass, the surgeon then cuts off the view of the object first from one of the patient's eyes and then from the other, watching their movements as he does so. When the object is concealed from the squinting eye, the other one, being already rightly directed, will remain stationary to continue the act of seeing, and the squinting eye will also remain stationary; but, when the object is concealed from the working eye, the other, or squinting eye, being wrongly directed, and not receiving the image of the object upon its yellow spot, will make a slight outward movement in order to take up correct fixation. At the same moment, the working eye, behind the obstruction, will execute an inward movement of somewhat greater amplitude than the outward movement of its fellow. Let it be supposed that there is slight weakening of the right externus, producing slight inversion of the right eye. When the object is screened from the right eye, the left still sees it clearly and sharply, and both eyes remain at rest. When the object is screened from the left eye, the right receives the image upon a point of its retina internal to its yellow spot, and sees it only indistinctly. The right eye, therefore, makes an excursion outwards, sufficient in amount to bring the image of the object upon its yellow spot, and to enable it to see better; but the motor impulse by which the necessary movement of the external rectus is called forth, is conveyed at the same time to the internal rectus of the left eye, as a result of the habitual association of the two eyes and of their muscles in the act of looking towards the right; and the sound muscle, under a given motor impulse, contracts more vigorously than the weakened one. The result is that the excursion inwards of the working eye is larger than the excursion outwards of the squinting one; and in this way the fact of paresis of the right externus is rendered manifest.

This form of strabismus is at first attended by distressing double vision, which often produces giddiness, but which diminishes in time, as the patient learns to neglect or mentally to suppress the image of the squinting eye. The smaller the deviation, the more distressing will be the double vision; because, the nearer to the yellow spot is the image of the squinting eye, the more definite will it be, and the less readily will it be distinguished from that of the other. In cases of very slight deviation, the equality of the double images renders it difficult to tell the true from the false, and leads the patient into frequent error with regard to the position of the object looked at.

Treatment.—The treatment of paralytic strabismus is primarily that of the syphilis or of the nerve-exhaustion upon which the paralysis depends; but it is also necessary to endeavour to minimise the inconveniences of the double vision while it continues, and to provide against permanent degeneration of the paralysed muscle from disuse. The former indication may be fulfilled by covering the squinting eye with a patch, or with an opaque glass in a spectacle frame, and, as the double vision is only troublesome when the eyes are directed to the side of the affected muscle, it is often sufficient to render opaque, by grinding or otherwise, the outer half of the glass which covers the affected eye. The nutrition of the muscle may be preserved, when the paralysis is incomplete, by systematic voluntary endeavours to call it into action; these endeavours being made three or four times a day for a few minutes at a time. For this purpose, the working eye should be closed or covered, and the squinting eye should be directed as much as possible towards the outer side. When the paralysis is complete, so that the eye cannot be carried beyond the middle line of its eyelid-opening, it is necessary to exercise the affected muscle by localised electric currents, after the manner of Duchenne. In cases where there is no response to induced currents, those of a cell battery will sometimes be found effectual. The exercise by electricity should be repeated at short intervals, such as every two or three days, until the nerve-function is beginning to be restored, so that the muscle can again be exercised by the will.

In cases of paralytic strabismus of old standing, it is sometimes necessary to have recourse to tenotomy of the contracted internus, before the eye can be restored to its correct position. It may be laid down as a general principle that every case can be cured, by combined tenotomy and volitional or electrical exercises, as long as the paralysed muscle will respond, in however small a degree, either to the will or to one form or other of electric current; but that, where the eye does not move outwards in obedience to the will, and where neither induced nor battery currents produce contraction of the paralysed muscle, no good is to be expected from either operative or medicinal treatment.

(*b*) *Convergent strabismus due to excessive development of both interni.*—Ætiology.—As a result of errors of refraction, about 90 per cent. of this class of cases are due to flat-eye or *hypermetropia*. The flat formation of the eye requires, for acute vision of near objects, a strenuous accommodation-effort; and this, by the intimate association which exists between the nerve-centres governing the accommodation muscles, and those governing the interni, produces a corresponding effort of convergence. As soon as a child who is born with flat eyes begins to take careful notice of near things, his accommodation muscles and his internal recti are both called into frequent and energetic exercise; and the consequence is that the interni become excessively developed in relation to their antagonists, the externi, so that the normal, or resting position of the eyes, instead of being one of parallelism, becomes one of convergence. The result of this is that the child would receive double images, of equal intensity, of all objects situated either nearer to him, or farther from him, than the point at which the convergent optic axes would meet if prolonged. Let us suppose that this point is one foot

distant from the eyes; and that the child wishes to look at an object which is eighteen inches distant. He cannot do this with both eyes, because the externi are unable to overcome their more powerful antagonists. If, however, he combines the right externus with the left internus, as in the act of looking to the right with both eyes, he becomes able to fix the object correctly with his right eye; and if he combines the left externus with the right internus, as in the action of looking to the left with both eyes, he becomes able to fix the object correctly with his left eye. But as, in either case, both eyes start from a position not of parallelism but of convergence, the effort which carries the right eye from its convergent state to the middle of its palpebral fissure will carry the left from its convergent state to one of much greater convergence, and *vice versâ* with the left eye; so that, while one eye is directed to the object of vision, the other is rolled far inwards. In this way, the image is received upon the yellow spot of the working eye, and upon so peripheral a portion of the retina of the squinting eye that it is easily neglected by the consciousness, and ceases to be a source of confusion or embarrassment.

Diagnosis.—The state of things in an ordinary case of squint beginning in childhood is the following. In a state of rest, as when the attention is not directed to any object, or during sleep, or under an anæsthetic, the eyes are equally convergent; but as soon as any object is looked at, one eye fixes this object and the other rolls inwards. If the degree of flatness is alike in both eyes, and if the muscles in both are of equal power, sometimes one will be the squinting eye and sometimes the other; and in most cases this condition obtains for a time. The squint is then said to be 'alternating.' Generally speaking, however, it is for some reason easier to work with one eye than with the other; either because it is flat in a less degree, or because its accommodation muscle or its external rectus is stronger than the corresponding muscle of its fellow; and then this eye is used in preference to, and gradually supersedes, its fellow; becoming always the working, while that is always the squinting eye. The squint is then said to be 'permanent.'

Treatment.—It would appear at first sight, from the rationale of the affection, that the squint which depends upon flat-eye could always be prevented, or even cured, by the habitual use of convex spectacles; but, as a matter of fact, the balance of power between the externi and the interni becomes deranged at so early a period of life, that spectacles could not be applied until too late. In every pronounced case of strabismus, it is necessary to perform tenotomy of the interni, sometimes only of one but far more frequently of both; and the only question to be considered is that of the time most favourable for the operation.

In determining this question, the points chiefly to be taken into account are the state of vision, and the age of the patient. When a squint becomes permanent, the vision of the habitually squinting eye frequently becomes impaired, apparently as a result of the continued mental suppression of the image which it receives; and in a person who is suffered to grow up to adult age squinting, this impairment of vision often falls little short of blindness, and admits of no remedy. No change is discoverable, generally speaking, by the ophthalmoscope; but the power of responding to impressions upon the retina seems to be lost. On the other hand, as long as the squint is alternating, and each eye is used by turns, the sight does not usually suffer.

The immediate effect of tenotomy of one or both interni is to release the eyes from their position of enforced convergence, and to diminish the power of the interni to rotate them inwards. The divided muscles soon acquire new attachments farther back upon the eyeball than their former ones, so that their power is permanently diminished, and this diminution may even be in excess, so as to leave an undesirable preponderance of the externi, and a corresponding tendency to eversion. The surgeon, even by the best planned operation, cannot absolutely determine the future position of the eyes. That determination has to be effected by the muscles themselves under the guidance of vision; and a perfect result after a squint operation, by which is meant the restoration of parallelism when at rest, without impairment of the power of volitional convergence, can only be obtained by an instinctive re-arrangement of the muscular forces concerned, a re-arrangement mainly brought about by efforts to avoid double vision, which is often the immediate result of an operation. While, therefore, it is always possible to remove by tenotomy a coarse and manifest malposition, it is only possible to obtain a perfect result when the recti muscles are well-developed, when the acuteness of vision is equal or nearly so in the two eyes, and when the power of attention to visual impressions is sufficiently active to render double images distressing. The muscular development and the power of attention are both deficient in early childhood; and hence, so long as vision does not suffer, it is better to defer operating for squint until about eight years of age. As long as the squint is alternating, there is no fear that the vision will suffer, and it is then safe and desirable to wait; but, as soon as the squint becomes permanent, it is necessary to test the vision of the squinting eye from time to time, and to provide for this eye being exercised every day, by keeping the other closed or covered for short periods. If, in spite of such exercise, the vision of the squinting eye is found to be undergoing progressive deterioration, the operation should be performed without delay, at however early an age; and the parents should be warned that it may perhaps be necessary, for the attainment of perfect harmony of movement between the two eyes, to operate again at some future time.

It will sometimes happen that a child is first brought for advice at an earlier age than eight, in whom the squint has already become permanent in one eye, and in whom the vision of that eye has already begun to suffer. In such cases, it is best to devote a few weeks to endeavours to improve the vision of the squinting eye by compulsory exercise; and if these endeavours should be in any degree successful, to continue them as long as improvement under their employment is perceptible. If no improvement

should be produced, the operation should be performed without further loss of time.

(*c*) *The convergent squint of short-sighted people.*—This is not a very common affection, and depends upon the fact that, spectacles to afford distant vision not having been worn, the externi, which produce the approximate parellelism of the optic axes required for distant vision, have not been exercised; while the interni have been constantly exercised in producing convergence for the vision of near objects. The former muscles, therefore, have been suffered to fall into a condition of feebleness from disuse, while the latter have undergone abnormal development. In such cases the eyes are usually equally convergent, such a position giving single vision of near objects; while double vision of distant ones is not irksome, on account of the indistinctness with which they are seen.

Treatment.—When the convergent squint of of a short-sighted person is of small magnitude, it may sometimes be cured by wearing glasses which correct the short-sight for distance, and call upon the external recti to take up their proper function. More frequently, however, they fail to respond; double vision is produced; and tenotomy, followed by the use of the spectacles, is required. Such cases usually turn out perfectly well.

2. **Divergent squint.**—This is nearly always a consequence of defective vision of the squinting eye, which wanders outwards for want of guidance from visual impressions. It may also follow from unskilfully performed or excessive operations for the cure of convergent squint.

Treatment.—The operation for divergent squint is not a mere tenotomy, but requires the shortening of the internal rectus of the squinting eye, or its advancement to a point of attachment nearer to the corneal margin; and the results of such an operation are less under command than those of tenotomy. The muscle may not attach itself firmly in the new position, or the connecting medium may stretch after a short time. The operation may be undertaken more hopefully, the better the vision of the divergent eye; and it is often very successful. It is nevertheless most prudent, in every instance, to prepare the patient for the possibility of failure, or of only partial success. It is in no case likely that the defect will be increased by failure of the operation; and, as the chief motive for its performance is usually the improvement of appearance, it may be undertaken with propriety in almost every case.

3. **Complex squint.**—The forms of strabismus in which the deviation is either upwards or downwards are not sufficiently numerous to be brought under any general rule. They depend either upon spasm of the muscle producing the deviation, or upon paralysis or paresis of its antagonist; and every case must be investigated and treated upon its merits, by tenotomy or electrisation, or both combined, according to the particular circumstances. Various irregular forms of strabismus are also seen, in the course of certain acute and chronic diseases of the nervous system, which entail loss or impairment of muscular co-ordination, such as meningitis and locomotor ataxy; but such forms are usually easily to be distinguished as symptoms of the general disorder, requiring no treatment or consideration apart from it. In chronic diseases, such as locomotor ataxy, it may be conducive to comfort to exclude the squinting eye from vision, for the purpose of obviating the inconveniences incidental to double images.

R. Brudenell Carter.

**STRANGULATION** (*strangulo*, I choke). In pathology this term is employed to express either the process or the condition of constriction of a tube, when it is so complete that the passage of the contents is prevented. *See* Hernia; and Intestinal Obstruction.

**STRANGULATION as a Mode of Death** (*strangulo*, I choke).—Synon.: Fr. *Strangulation*; Ger. *Erwürgung*.

Definition.—The act and effect of constriction of the neck and air-passages by means of a ligature or manual pressure (throttling). Death results essentially from asphyxia.

Ætiology.—Strangulation is chiefly homicidal, but it may be suicidal or accidental. Accidental strangulation may occur in a variety of ways, as in the case of a child from tightening of a cravat round the neck, from the end catching in the wheel of a perambulator; in the case of a drunken woman by fixation and tightening of her bonnet-strings; and in the case of a cripple by a rope attached to a weight accidentally becoming tightened in front of the neck.

It was at one time doubted whether suicide could be effected by strangulation, owing to the fact that the hands relax when insensibility comes on, rendering it impossible to keep up sufficient tension on the ends of the ligature. But when the ligature is wound more than once round the neck, or some method is adopted by which the ligature can be tightened like a tourniquet, as by the insertion of a piece of stick which catches behind the ear or elsewhere, it is quite possible; and numerous instances are on record of suicide so effected. In most cases, however, the presumption is in favour of homicide, and in all cases of strangulation by manual pressure this may be looked upon as certain.

Signs.—In addition to the general indications of asphyxia (*see* Asphyxia), there are special signs of strangulation which vary with the degree of force employed, and the amount of resistance offered by the victim.

To strangle an individual of normal strength, and in full possession of all his faculties, is barely possible, without causing evident signs of violence on various parts of the body. The existence of injuries of this kind is valuable evidence of the mode of death. Very often cranial injuries are found, from the individual having been first knocked down by a blow on the head. Ecchymoses, abrasions, and other signs of mechanical violence are generally to be found in various parts of the body. If the strangulation has been effected by manual pressure, the front or sides of the neck exhibit bruised marks, corresponding to the thumb and fingers, with, perhaps, curved excoriations corresponding to the nails. The relative size of the marks produced by the thumb and fingers, and the direction of the nail marks,

indicate the way in which the pressure has been exerted, and whether with the right or left hand.

When a ligature has been employed, a mark is left on the neck, which varies with the nature of the ligature, and the way it has been disposed. Usually it is a transverse, shallow furrow; single, double, or multiple, according to the number of folds; and continuous, or interrupted in places. The bottom of the groove is generally pale, and not parchmented as in hanging, owing to the pressure not being kept up so long as to lead to dessication. Ecchymoses in the course of the groove are met with more frequently than in hanging, owing to the great violence frequently exerted.

Very commonly punctated ecchymoses are visible on the conjunctivæ, face, neck, and chest. They are considered by Tardieu to be more frequent in strangulation than in asphyxia from other causes, or from overstraining, which likewise may lead to them. In the subcutaneous cellular tissue, and in the fasciæ of the muscles above and below the hyoid, extravasations are frequently found, as well as on the external surface of the thyroid cartilage and trachea. The lungs vary as regards their vascularity, but on the surface it is common to find pseudo-membranous patches, which are due to the rupture of some of the superficial air-cells and collection of air-bubbles under the pleura. In the substance of the lungs congested patches, or apoplectic extravasations, are often found, varying in size, according to Tardieu's description, from half a franc up to a five-franc piece—extravasations, therefore, much larger than those usually found in suffocation.

Treatment.—The treatment of asphyxia from strangulation is that of asphyxia in general. *See* Artificial Respiration; Asphyxia; and Resuscitation.

D. Ferrier.

**STRANGURY** (στράγξ, a drop, and οὖρον, urine).—Synon.: *Stillicidium urinæ*; Fr. *Strangurie*; Ger. *Harnstrenge.*

Definition.—A condition characterised by a frequent and urgent desire to pass the urine, which is voided in drops or in very small quantities, with a sense of painful spasm in the perineum, and often with no feeling of relief.

Ætiology.—Strangury occurs under such a great variety of circumstances that it can be regarded only in the light of a symptom. It is found in nephritis or intense congestion of the kidney, however induced; and thus becomes a symptom after the administration of large doses of turpentine, or the use of cantharides, either internally or in the form of a blister. It likewise occurs in acute or chronic inflammation of the bladder, prostate, and urethra; in hypertrophy of the prostate; in cancer and other tumours, and in stone of the bladder; and in advanced stricture of the urethra.

Treatment. 1. *Preventive treatment.*—Strangury may be prevented from following the application of a blister to the surface of the body, by allowing it to remain on but for a short time, following it by a poultice, or by sprinkling the skin of the part with powdered camphor.

2. *Curative treatment.*—Regarding strangury as but a symptom of some other morbid condition, we must consider it as we should cough, headache, or dropsy, and treat it with a view to removing the condition on which it depends. With regard to relieving the more urgent local symptoms, warm hip-baths and fomentations, hypodermic injections of morphia, and suppositories of morphia or of belladonna, may be used with advantage.

**STRATHPEFFER, in Ross-shire.**—Sulphur waters. *See* Mineral Waters.

**STRICTURE** (*stringo*, I bind).—A contraction of a tube, duct, or orifice; for instance, of any part of the alimentary canal or of the urinary passages. *See* Urethra, Diseases of.

**STRIDOR: STRIDULOUS** (*strideo*, I creak).—Stridor is the name given to a peculiar noisy form of breathing, produced in the larynx; varying greatly in its character—being either harsh, musical, or crowing; and due to various forms of obstruction. The term *stridulous* is applicable to the respiration, the cough, or the voice, when they possess the characters of stridor. *See* Larynx, Diseases of; Pneumogastric Nerve, Diseases of; and Voice, Disorders of.

**STROKE.**—A popular synonym for an attack of apoplexy or sudden paralysis; but also used in the compound words, *sun-stroke*, *heat-stroke*, and *wind-stroke*, to indicate the effects of these agents.

**STRONGYLUS** (στρογγύλος, cylindrical). Synon.: Fr. *Strongle*; Ger. *Pallisadenwurm.*—A genus comprising many species of nematoid worms. The large kidney-worm, sometimes called *Eustrongylus gigas*, has only once been found in the human body. The case was undoubtedly genuine, and the specimen is still preserved in the museum of the Royal College of Surgeons. *See* Sclerostoma.

**STRONGYLUS DUODENALIS.** *See* Sclerostoma.

**STROPHULUS** (στρόφος, a twisting of the bowels, or colic).—Synon.: Fr. *Strophulus*: Ger *Schälknötchen.*

Definition.—A papular eruption of the skin in infants; referable, as the derivation of the word implies, to derangement of the bowels.

Description.—The eruption is a lichen, a form of folliculitis, rarely extensive, and unassociated with constitutional symptoms. Its principal seat is the face, but it may also be dispersed over the trunk of the body and limbs. Its duration will be influenced by the nature of its cause.

Some variety in colour, duration, and cause has given rise to several names applied to the eruption. It is sometimes ephemeral, and has been termed *S. volaticus*; sometimes the pimples are pale or shining, hence *S. albidus* and *S. candidus.* More frequently they are red and inflammatory, and either dispersed or aggregated, *S. confertus*; and occasionally an interpapular hyperæmia or inflammation gives rise to the variety known as *S. intertinctus.* When associated with dentition this trivial rash is termed 'red gum' and 'white gum'; whilst under conditions of aggravation it is prone to run into eczema.

Treatment.—The treatment of strophulus is one of attention to the general health and condition of the infant. A few doses of magnesia and rhubarb, and even a grain of calomel, may sometimes be found useful, but in general a discreet attention to the food, with rest and warmth, will be all that is necessary. Locally, the rash should be dusted over with fuller's-earth powder, or sponged with a lotion of lime-water and oxide of zinc, with or without calamine.

Erasmus Wilson.

**STRUCTURAL DISEASES.**—Diseases attended by recognisable anatomical changes, as distinguished from *functional* diseases. *See* Disease, Classification of.

**STRUMA**
**STRUMOUS** } (*struma*, a scrofulous swelling.)—Synonyms for scrofula and scrofulous. *See* Scrofula.

**STRYCHNIA, Poisoning by.**—Synon.: Fr. *Empoisonnement par la Strychnine*; Ger. *Strychninvergiftung*.—The seeds of *Strychnos nux vomica*, commonly known as *nux vomica*, as well as several other plants, owe their powerful toxic (excito-motor) properties to an alkaloid, *strychnia*; and in a minor degree to another alkaloid, *brucia*, which is said to produce the same physiological effects as strychnine. Strychnia is a white crystalline substance, very sparingly soluble in aqueous liquids, to which, however, it communicates an intolerably bitter taste. It is more freely soluble in acid and alcoholic liquids. When mixed with flour and sugar, and coloured by admixture with either soot or Prussian blue, strychnia forms the basis of several well-known forms of 'vermin-killer.' Spite of its repulsively bitter taste, strychnia has been administered with homicidal intent in such liquids as infusions of tea and cocoa, and in other media.

Anatomical Characters.—The anatomical characters after death by strychnia-poisoning are very ill-marked, and at most consist of some congestion of the vessels of the spinal cord; and even this may be wanting.

Symptoms.—Except when taken in the form of pill, strychnia and all substances containing it produce an immediate and intensely bitter taste, which is also at the same time of a quasi-metallic character, and is very persistent. Since the fatal dose—half a grain of the alkaloid—is small, and the poison is readily soluble in the acid gastric fluid, its physiological effects are, as a rule, not long delayed. They may be unmistakable after the lapse of two minutes; but commonly they are not well-marked till five, ten, or even twenty minutes after administration. They begin with a stage of restlessness, excitement, and a vague sense of impending peril. The special senses, too, are often preternaturally sharpened. A feeling of choking or impending suffocation ensues; then there is a trembling of the whole body; jerkings of the head; and often, in a moment, the whole body becomes stiff and rigid, assuming a bow-like form, (opisthotonos), *i.e.*, arched forwards and resting perhaps on the head and heels only. The muscles even of the chest and abdomen are tense and fixed, so that respiration is impeded, giving rise to more or less cyanosis. The feet are either incurvated or excurvated. The angles of the mouth are drawn down, so as to give rise to the well-known *risus sardonicus* of tetanus. Attempts to administer medicine by either cup or spoon have been known to result in the patient's biting the cup or spoon in two, in consequence of a violent spasmodic closing of the jaws. During the paroxysm, and indeed throughout the intoxication, the cerebral faculties are unimpaired, and the convulsions are purely of spinal origin. The pupils are dilated. In a few minutes, and often in half a minute, the muscular tension relaxes, and there is a complete remission of the spasms. The patient lies exhausted, and bathed in perspiration; the rapid pulse of excitement falls in frequency; respiration becomes more normal; and the dusky lividity of the countenance passes off. This remission is, however, of no long duration. A gentle touch, a footstep, even a breath of air impinging on the patient, results in a new crisis; and often with a wild, despairing cry, a renewed convulsion, similar to but more intense than the preceding one, is ushered in. The patient rarely dies during the first or second paroxysm, but the alternation of convulsions and quiet is repeated again and again till death ensues, usually in half an hour or an hour; or in non-fatal cases the fits become less and less frequent, less intense, and eventually cease. Death takes place commonly during a paroxysm, from asphyxia; but it may also occur in the intervals between the paroxysms, from exhaustion.

Diagnosis.—The characteristics of strychnia-convulsions are so well-marked, as already described, that there is little likelihood of the nature of the case being overlooked; and the only disease with which strychnia-poisoning can readily be confounded is tetanus—traumatic, idiopathic, or hysterical. In the hysterical form of the disease, as described by some writers, the well-marked hysterical symptoms, the closed or half-closed eyes, the desire to be fanned, and the incomplete remissions of spasm, serve for diagnosis. Except in the history there is nothing to distinguish between the traumatic and idiopathic forms of the disease, so that what is here stated with regard to the diagnosis between strychnia-tetanus and traumatic tetanus, applies also to the idiopathic form. In traumatic tetanus the muscular symptoms begin with pain and stiffness of the neck and jaws, gradually passing into spasms; and the jaw is one of the earliest parts affected. The strychnia-symptoms, on the other hand, develop rapidly, and begin in the extremities, or a general convulsion at once seizes the whole body. Moreover, the jaw is usually last affected, and its muscles relax first. The strychnia-relaxation is complete, or rarely almost complete; whilst in traumatic tetanus there is permanent muscular rigidity, and no complete remission of spasm. Strychnia-tetanus is an affair of minutes, or at most of half a dozen hours; whilst traumatic tetanus never kills within twelve hours, and generally extends over a few days. In strychnia-poisoning the most trivial movement or touch will set up a convulsion; whilst during the spasms firm grasping of the hands, and hard rubbing of the rigid muscles, will often afford grateful relief. This

distinction is not marked in traumatic tetanus. An analysis of the urine by Stass's method, which often affords certain indications of strychnia, and may be made in a few minutes, will, in doubtful cases, at once remove all uncertainty as to the nature of the disease.

PROGNOSIS.—The prognosis is at all times doubtful. The patient's life cannot be considered safe till the convulsions clearly exhibit marked decrease, both in frequency and intensity.

TREATMENT.—Should the convulsions have already set in, the use of the stomach-pump is out of the question. An emetic of warm water with mustard, or carbonate of ammonia, should be given without a moment's delay. The patient should be touched as little as possible, and absolute quiet observed in the sick-room. Excellent results have ensued from the administration of large doses of bromide of potassium; even half an ounce in one dose has been given. The salt serves the double function of rendering the poison insoluble, and counteracting its physiological effects. The gastric irritation produced by such large doses of the bromide as are necessary militates against its use. Chloral in full doses, and the anæsthetic administration of chloroform vapour, are the best remedies. The free use of chloroform not only alleviates the pain and allays the spasms, but allows time for the elimination of the poison from the system. Nitrite of amyl has been recommended by Dr. Barnes. Strychnia-poisoning more often ends fatally either from the lateness with which remedies are applied, or their non-application, than from their inefficient character.

THOMAS STEVENSON.

**STUPE** (*stupa*, tow.)—A synonym for a fomentation. *See* FOMENTATION.

**STUPOR** (Lat.).—SYNON: Fr. *Stupeur*; Ger. *Stupor*; *Stumpfsinn*.—A partial loss of consciousness. *See* CONSCIOUSNESS, Disorders of.

**STUTTERING.** *See* STAMMERING.

**STYPTICS** (*στύφω*, I constringe).—DEFINITION.—In former years this term was held to include internal astringents, like the famous Ruspini's styptic, of which gallic acid was the principal ingredient, but we now limit its use to substances locally used to arrest hæmorrhage.

ENUMERATION.—The chief styptics are Cold, the Actual Cautery, Perchloride of Iron, Tannin, Matico, strong Acids, Alum, Acetate of Lead, and Collodion.

ACTIONS AND USES.—One class of styptics encourages the coagulation of the blood, by supplying a rough material around which fibrin may be deposited, in obedience to a well-known physiological law; the principal of these being matico, tannin, and the old-fashioned cobweb. Others, in addition to their primary action in favouring the formation of a clot, coagulate the albumen of the tissues, or, like acetate of lead, cause the bleeding mouths of the smaller vessels to contract. The use of styptics is usually limited to the general oozing which is observed occasionally to follow the application of leeches, or the infliction of small wounds by accident or for surgical purposes, and may render essential service under a great variety of circumstances. If ice, pressure, or posture fail to check bleeding, we may have recourse to some of the more potent applications.

R. FARQUHARSON.

**STY** (Sax. *steigan*, to rise up).—SYNON.: *Hordeolum*; Fr. *Compère-Loriot*; *Orgelet*; Ger. *Gerstenkorn*.

DEFINITION.—A boil on the margin of the eyelid.

DESCRIPTION.—A sty does not differ in any essential respect from a boil in any other situation, but it is usually of small size, and commences in the follicle of an eyelash. Sties are most common in young people, especially in anæmic girls, and are often very troublesome by frequent recurrence, in which case they may create a certain amount of permanent disfigurement by destroying hair-bulbs, and producing bald gaps in the eyelid margins. They are mostly associated with some obvious derangement of the general health, which should be made the subject of treatment.

TREATMENT.—An individual sty, if seen sufficiently early, when it is as yet only a small pimple, may often be rendered abortive by pulling out the eyelash which passes through it, and touching the spot with a fine point of nitrate of silver; but, when the time for this method has passed away, there is nothing to be done locally beyond the application of a fomentation or poultice, and a touch with a sharp lancet as soon as pus can be seen. Pain is at once relieved by the incision, and the swelling speedily subsides.

R. BRUDENELL CARTER.

**SUBACUTE.**—A term applied to a disease when it has characters intermediate between acute and chronic, whether in *course* or in *intensity*. *See* ACUTE; CHRONIC; and DISEASE, Duration of.

**SUBCUTANEOUS INJECTION.** *See* HYPODERMIC INJECTION.

**SUBSTITUTION.**—This word is used in pathology in connection with degeneration, when a newly-formed tissue, inferior to the original in organisation or functional activity, takes the place of the normal structure. *See* DEGENERATION.

**SUBSULTUS TENDINUM** (Lat.).—A twitching movement of the tendons, caused by sudden momentary contractions of the muscles to which they belong. This is especially apt to show itself in the tendons about the wrist in the later stages of many low fevers. It manifests itself principally in states of great prostration, and is often associated with delirium or other signs of cerebral irritation. *See* TYPHUS FEVER.

**SUCCUSSION** (*succussio*, a shaking).—A method of physical examination, which consists in suddenly shaking the trunk of the patient, so that certain sensations or sounds may be produced, which are indicative of the presence of gas and fluid in a hollow space, such as the pleural cavity. *See* PHYSICAL EXAMINATION.

**SUDAMINA** (*sudor*, sweat).—SYNON.: Fr. *Sudamina*; Ger. *Schweissbläschen*.—This term is applied to minute vesicles of the cuticle, associated with a relaxed and perspiring state of the skin. In size they have been compared to a millet-seed, *milium*; and when they occur in

considerable numbers they constitute the eruption known as *miliaria* (*see* Miliaria). In some instances they would seem to be produced by rupture of the sudoriparous ducts, and escape of the sweat into the rete mucosum of the skin. *See* Sudoriparous Glands, Diseases of.

Erasmus Wilson.

**SUDORIFICS** (*sudor*, sweat, and *facio*, I make).—A synonym for diaphoretics. *See* Diaphoretics.

**SUDORIPAROUS GLANDS, Diseases of.**—Synon.: Fr. *Maladies des glandes sudoripares*; Ger. *Krankheiten der Schweissdrüsen.*—The perspiratory, sudoriparous, or sweat glands are subject to varieties of development and growth; and likewise to changes resulting from a low degree of inflammation, or of congestion, of their capillary blood-vessels.

1. **Atrophy and Hypertrophy.**—We may recognise both atrophy and hypertrophy of the sudoriparous glands, but they are very rare affections.

2. **Subacute Inflammation.**—Synon.: *Hydroadenitis.*

This disease of the sweat-glands originates with hyperæmia, which renders the glands visible through the cuticle, and in rare instances passes into the formation of a minute quantity of pus, and pustulation. Another affection of the perspiratory glands, beginning with congestion and disintegration of the epithelium of the excretory duct, and resulting in the formation of minute globules of transparent fluid, which either remain in the deep stratum of the epidermis, or are developed into isolated single or multilocular vesicles, followed by exfoliation, is limited to the fingers and hands, particularly their palmar surface. This affection has received the names of (1) *dysidrosis* (Tilbury Fox), from the presence of a mechanical impediment to the escape of the sweat; and (2) *cheiropompholyx* (Hutchinson), from the association of clusters of vesicles, which occasionally form a multilocular bleb of moderate elevation, and of about half an inch in breadth. Occasionally the bleb may become in appearance a real pompholyx, and cover the whole of the palm of the hand, in which case the fluid which it contains is remarkable for its putrid odour.

Diagnosis.—Dysidrosis is distinguished from eczema by the absence of superficial inflammation and exudation; by the apparent depth within the epidermis of the sero-globules; by their tendency to resorption; by their limitation to the hands and occasionally the feet; and by the absence of eczema on other parts of the body. From a certain resemblance, the sero-globules of dysidrosis have been compared to sago-grains. It is not a grave affection, but is undoubtedly troublesome, and is usually met with in persons of delicate health, especially females, and during or after a hot season.

Treatment.—In disorders of the sudoriparous glands the general health predisposing to such affections is chiefly to be considered. This is especially the case in dysidrosis, which calls for the use of tonic remedies, and a generous diet. Locally, the best remedies, in all stages of the complaint, are lotions of oxide of zinc or prepared chalk with lime-water. In other cases painting with liquor plumbi has proved very successful.

Erasmus Wilson.

**SUFFOCATION** (*suffoco*, I stifle).—Synon. Fr. *Suffocation*; Ger. *Erstickung.*

Definition.— The term suffocation is sometimes employed synonymously with asphyxia. In the strict medico-legal sense it signifies asphyxia induced by obstruction of the respiration otherwise than by direct pressure on the neck (hanging, strangulation), or submersion (drowning).

Ætiology.—Death by suffocation is usually the result either of *accident* or of *homicide*, rarely of *suicide.*

*Suicide* by suffocation is not, however, unknown. Cases of suicide by immurement in a box or trunk, or by thrusting a pad or other obstruction down the throat, have been reported; and it has been averred that slaves, both in ancient and modern times, have committed suicide by rolling the tongue back into the pharynx.

*Accidental* suffocation is very common by diseases causing occlusion of the air-passages; by the impaction of pieces of food or other obstacles in the pharynx; by the entry of foreign bodies into the larynx, as a seed, coin, or food in cases of bulbar or general paralysis, or matters vomited in a state of insensibility; by mechanical pressure on the chest and abdomen, as in crowds, or in falls of earth or heavy bodies; by various diseases preventing the expansion of the lungs; by diseases of the lungs themselves; or by obstruction of the pulmonary circulation. Suffocation of new-born children by smothering under bedclothes, non-removal of maternal envelopes, or overlying, may happen from carelessness as well as from intent. *See* Overlying.

*Homicidal* suffocation is resorted to chiefly in infants, or in the case of persons feeble and infirm, or rendered powerless or insensible by intoxication or narcotics. Closure of the mouth and nostrils by the hands, or obstruction of the mouth and nostrils by a pillow, mattress, or the like, perhaps combined with pressure on the chest, is the method usually adopted. Formerly suffocation by mechanical pressure on the chest was a judicial punishment—the *peine forte et dure.*

Symptoms and Signs.—The mode of death, and the general *post-mortem* indications are those of asphyxia (*see* Asphyxia). The special indications of suffocation, and the way in which it has been brought about, may be evident from the place where the body is found, and its surroundings; or foreign bodies, or disease obstructing the air-passages or respiratory mechanism, may be clearly evident on *post-mortem* dissection; or there may be marks of violence and indications of pressure on the chest, flattening of the nose, &c., pointing to homicidal violence. The absence of marks of constriction of the neck excludes strangulation and hanging.

But in the absence of all such indications as have been enumerated above—and they may all be absent, especially in cases of infanticide—the question is whether any trustworthy conclusion can be formed as to asphyxia by suffocation.

The condition of the lungs is of especial importance in this relation. The lungs may be

congested, or pale, or congested only posteriorly; but the surface is often uneven, owing to an emphysematous condition of some of the superficial air-cells; and in particular the lung looks as if it had been sprinkled with minute drops of a dark purple fluid. These spots, not much larger than a pin's head, are known as 'Tardieu's spots,' and are due to minute capillary extravasations under the pleura. They are not, however, confined to the surface of the lungs, but are found also in considerable numbers on the thymus gland, the base of the great vessels, under the parietal pleura, and also under the pericranium. Tardieu, who first called special attention to these spots, considered them absolutely diagnostic of death by suffocation, as distinguished from other modes of asphyxia. But numerous other observations have shown that this cannot be accepted as correct, inasmuch as similar extravasations have been found in cases of hanging, strangulation, drowning, and deaths from cerebral injuries. It seems, however, fairly well established that they occur most frequently, and in largest number, in suffocation, especially in infants. Their formation depends on excessive vascular tension during the asphyxiating process. Similar spots have been found in the lungs of still-born fœtuses, conditioned by obstruction of the placental circulation; and in the lungs of newborn children perishing from other causes, extravasations of a like nature have been observed. It would, therefore, be unsafe to rely absolutely on Tardieu's spots as indications of suffocation, though, in the absence of other causes of death, and in presence of these spots in large numbers and in clusters, the opinion of death by suffocation would be fairly justified.

Treatment.—The treatment of impending suffocation is that of asphyxia. *See* Artificial Respiration; Asphyxia; and Resuscitation.

D. Ferrier.

**SUFFOCATIVE BREAST-PANG.**—A synonym for angina pectoris. *See* Angina Pectoris.

**SUFFOCATIVE CATARRH.**—A synonym for asthma. *See* Asthma.

**SUFFUSION** (*suffundo*, I pour down).—The process or the result of the unnatural pouring out of a fluid into the tissues; closely analogous to effusion and extravasation. *See* Extravasation.

**SUGGILLATION** (*suggilo*, I make black by beating).—The appearance produced by extravasation or ecchymosis of blood. The term is limited by some authorities to the appearance of livid spots on the body after death.

**SUICIDAL INSANITY.** *See* Insanity, Varieties of—*Impulsive insanity*; and Melancholia.

**SULPHUR WATERS.** *See* Mineral Waters.

**SUNSTROKE.**—Synon.: Insolation; Heat-stroke; Fr. *Coup de Soleil*; Ger. *Sonnenstich*.

Definition.—Certain pathological conditions resulting from exposure to solar or artificial heat.

Three well-marked varieties of sunstroke are recognised, namely:—1. Exhaustion and failure of the heart's action in *syncope*; 2. A condition like shock, in which the nerve-centres, and especially the *respiratory*, are affected, causing rapid failure of the respiration and circulation; and 3. Intense *pyrexia*, due to vaso-motor paralysis, and to the nerve-centres being over-stimulated and then exhausted by the action of heat on the body generally.

Ætiology and Pathology.—These morbid conditions, being due to heat alone, are not peculiar to any country or climate, and are liable to occur wherever persons are exposed under any circumstances to great heat, whether solar or artificial. Soldiers marching or fighting, when oppressed by weight of clothing and accoutrements, are apt to suffer either from simple heat-exhaustion, or that form of insolation which results from direct action of the sun on the head and neck. This is common enough in India during the hot season, in other tropical countries, and in America; and is not unknown in Europe or even in England, during the heat of summer. Workmen, artificers, and stokers, and other persons in heated rooms, hospitals, barracks, tents, and even ships, especially in hot climates, are liable to suffer from heat-exhaustion, which may pass into the dangerous condition of fever or insolatio.

But the most frequent cases are those which come on in houses, barracks, tents, ships, by night or in the day, away from the direct solar rays. A form of disease sometimes described as 'ardent fever' in India, is this condition supervening on the ordinary phenomena of ephemeral fever. It seems pretty well understood that heat alone is the effective cause of the so-called sunstroke. Malarial and certain hygrometric or barometric states of the atmosphere have no special influence, beyond that which they may exert on the general vigour of the constitution, or in rendering a person more or less susceptible to heat, and so far predisposing him to suffer from it.

A dry air, such as that of North India, with hot winds, is much better tolerated at a high temperature, than the damp atmosphere of Bengal at a much lower one; for the dry hot air favours evaporation, and thus keeps the body cool, whilst in the damp, heavy atmosphere the natural cooling function is almost in abeyance. Vigorous, healthy persons of moderately spare frame, possessing sound viscera, and leading temperate and regular lives, can tolerate a great amount of heat, in an otherwise pure atmosphere, and are much less liable to suffer from it than those in whom these conditions do not exist. Acclimatisation has also considerable influence in conferring toleration. New arrivals are more prone to suffer than those who have become accustomed to the climate. It is well known that the native can bear an amount of sun on his shorn head, neck, and half-naked body with indifference if not pleasure, that would very soon prostrate a European. But to a temperature of the air rising above a certain standard, all succumb; and the natives of India suffer like others, and die in numbers every year from *loo-marna* or 'hot wind stroke.'

The exact amount and duration of toleration of a high temperature depend to a great

extent, therefore, on the vigour of constitution and the present state of health. The natural refrigerating powers of the body, when in health, are such as to enable men to support very high temperatures, much above that of the normal state of the body. Thus in the hot dry winds no inconvenience beyond discomfort is felt, so long as transpiration and perspiration are free, which cool down the body, enabling it to resist the great heat. It is obvious that in this there is a great expenditure of force, and when it fails suffering soon ensues. Disordered health, dissipation, over-fatigue, anything in fact that depresses nerve-power, reduces the normal physiological capacity, and consequently renders a man more liable to succumb.

Anatomical Characters.—In cases where death has taken plate suddenly, as from *shock*, there is no very remarkable appearance. The heart may be found firmly contracted, but not always so—it may be flaccid. The lungs and the brain and its membranes may be found somewhat congested, but not invariably. As in cases of shock, the venous trunks—specially those of the abdomen and the right side of the heart, may be found too full of blood, and the pulmonary vessels may be over-loaded with blood. The blood itself is dark and grumous, and is found effused in patches of ecchymoses, and indeed rendering the body more or less livid; the coagulability of the blood is also impared and it is wanting in oxygen.

In death from ordinary cases of *thermic fever* the lungs and pulmonary system are often deeply congested; the heart is firmly contracted, from coagulation of myosin; the whole venous system is engorged; and the body even before death is marked by petechial patches, or extensive ecchymoses of a livid appearance. The blood is generally more fluid and grumous than natural; its coagulability is impaired; and it is acid in reaction. The globules, though generally presenting no abnormal change, are somewhat crenated, and have less tendency to form rouleaux than natural; and the quantity of oxygen is much diminished. The body for some time after death retains a high temperature; when first opened the viscera feel pungently hot, and the incisions drip dark blood. *Rigor mortis* comes on very rapidly, from early coagulation of myosin.

The brain and membranes may be found congested, and in some cases there may be evidence of meningitis. Serous effusions into the ventricles, or hæmorrhage into the brain-substance, may have occurred, and are not improbable in the congested condition sometimes existing in the head; but the cause of death is asphyxia, not apoplexy, and the most important changes are found in connection with the thoracic viscera.

Symptoms—(1) **Syncopal form.**—Synon.: Heat-exhaustion.—Simple exhaustion and syncope may occur under great fatigue or over-exertion, or depression from any cause, during exposure to a high temperature. There is depression of nerve-force, and prostration of muscular power; the skin is pale, cold, and moist; and the pulse is quick and feeble. Death may occur rapidly in the state of collapse from failure of the heart. Complete recovery is frequent.

(2) **Asphyxial form.**—Synon.: Sunstroke proper.—Asphyxia and apnœa may come on very rapidly, after certain premonitory symptoms of depression and weakness, though occasionally without prodromata, during exposure, especially of the head and spine, to the direct rays of a powerful sun, when the atmosphere is much heated, and the nervous energy has been depressed by over-fatigue, dissipation, or illness. The brain and nerve-centres, especially the respiratory, are overwhelmed by the sudden elevation of temperature; and respiration and circulation fail, the failure of the latter being probably due to the inhibitory influence of the vagus. When death takes place, as it does sometimes, very suddenly, during great excitement or exertion, it has been attributed to rapid *ante-mortem* coagulation of the cardiac myosin. This, however, though it may occur occasionally, is generally a *post-mortem* change, the heart's action being brought to a close by the heat; in the same manner as it has been shown by Claude Bernard and Lauder Brunton that the effect of high temperature on animals is first to accelerate and finally to stop the heart, and especially the ventricles, in a state of contraction. Recovery is frequently complete, but sometimes tedious, and in many cases imperfect, ending in serious impairment of health or intellect, indicative of structural changes caused in the nerve-centres. The symptoms of this form of insolation, the real *coup de soleil*, are those of sudden and violent injury to the nerve-centres—unconsciousness and cold skin, feeble pulse, all the symptoms of depression; death resulting from rapid failure of the respiration and circulation. If not fatal, reaction may result in a variety of conditions indicative of the injury done to the cerebro-spinal system.

(3) **Hyperpyrexial form.**—Synon.: Heat-fever.—An intense state of fever, the result of the influence of heat on the nerve-centres, and through them on the vaso-motor nerves, and of the heating of the body generally, by the direct action of either artificial or solar heat, may occur, quite independently of the immediate operation of the sun's rays. It comes on as frequently at night, or in the shade, as in the day or in the sunshine, especially in persons who are exhausted by fatigue, overcrowding, depression from any cause, such as dissipation, want of rest, present or recent illness, and notably when the atmosphere is impure from overcrowding or want of cubic space.

The temperature of the body rises to 108°, 110° Fahr., or higher. The brain, medulla, and cord, the nerve-centres generally, and especially the respiratory, suffer from over-stimulation, followed by exhaustion. Respiration and circulation fail; there is dyspnœa, with hurried, gasping breathing; great restlessness; thirst; fever; frequent micturition; and a pungent burning heat of skin, which is sometimes dry, sometimes moist. The pulse varies; in some it is full and laboured, in others quick and jerking. The face, head, and neck are congested to lividity, and the carotid pulsations are visible. The pupils, contracted at first, may dilate widely before death. Delirious convulsions, frequently epileptiform in character, coma, relaxation of the sphincters, and suppression of urine come on.

and are frequently the precursors of death, which is due to asphyxia. Recovery not unfrequently partially occurs, to be followed by relapse and death; or secondary consequences, the result of over-heating, end in meningitis or cerebral changes, which may destroy life or intellect at a later period, or permanently compromise the whole health or that of some important function.

The premonitory symptoms of this form of insolation often manifest themselves for some hours, and it may be days, before they culminate in the dangerous condition just described. These premonitory symptoms are general malaise; disordered alvine or other secretions; profuse and frequent micturition; restlessness; sleeplessness, and apprehension of impending evil; hurried and shallow breathing; præcordial anxiety; giddiness and headache; occasionally nausea or vomiting; thirst and anorexia; and feverishness, which soon amounts to a pungent heat of skin with high temperature. These symptoms vary considerably, but they point to a profoundly disturbed state of the cerebro-spinal nerve-centres, and to pathological changes in the organs or structures whose functions have been so gravely disturbed. Death results from asphyxia and apnœa. Recovery is often incomplete; or is followed by permanent impairment of health, and generally by intolerance of heat and exposure to the sun.

Terminations.—The mortality from sunstroke is about 45 to 50 per cent.; but of those who recover many are permanently injured, and remain invalids for the remainder of life, which is often shortened by the changes induced. There may be some weakness, due to obscure structural change in the cerebrum, or to a chronic form of meningitis which affects the sufferer in various degrees of intensity; or epilepsy, impairment of memory, great nervous irritability, headache, insanity, partial paraplegia, partial or complete blindness, and extreme intolerance of heat—especially of the sun's heat, rendering the person utterly incapable of serving or living in a hot climate, or of enduring exposure to the sun. Or it may gradually end in complete fatuity, insanity, or meningitis—which accounts for the intense cephalic pain; or, in a lesser degree, in disordered innervation and derangement of the functions generally, thus seriously compromising the general health.

Treatment.—(1) In cases of *simple exhaustion* simple treatment is all that is needed. Removal to a cooler locality, the cold douche (but not too much prolonged), or the administration of stimulants may be beneficial. Tight or oppressive clothing should be removed, and the patient treated as in syncope from other causes. *See* Resuscitation.

Rest and freedom from exposure to over-exertion, fatigue, or great heat should afterwards be enjoined.

(2) In that form of sunstroke where the person is *struck down* suddenly by a hot sun, the patient should be removed into the shade. Here a douche of cold water must be allowed to fall in a stream on the head and body, from a pump (or as in India from the mussuck, or other similar contrivance), the object being twofold—to reduce the temperature of the over-heated centres, and to rouse them into action. During the assault on the White House picquet in the last Burmese war, numbers of men were struck down by the direct action of the sun during the month of April. They were laid out perfectly unconscious, in their red coats and stocks (worn in 1852), but were recovered by the cold douche freely applied by the mussuck over the head and body. In some cases flagellation with a broom was added; and all recovered with the exception of two cases, both of which had been bled on the spot where they fell. Mustard plasters and purgative enemata may also be useful.

If recovery be imperfect, and followed by any indication of injury to the nerve-centres, or by the supervention of meningitis, other treatment may be necessary, according to the indications. Much exposure to the sun should be carefully guarded against; and unless recovery be complete and rapid, the sufferer should be removed to a cooler climate, the most perfect rest and tranquillity of mind and body enjoined, and the greatest care observed with regard to extreme moderation in the use of stimulants.

(3) In the cases of *thermic fever*, heat being the essential cause of the disease, the object is to reduce the temperature of the body as quickly as possible, and before tissue-changes have resulted. As the hyperpyrexia is due not only to the direct operation of heat, but to fever set up, remedies such as may influence this disturbed condition have been suggested. The results have appeared in some cases to justify the theory, and the hypodermic injection of morphia or of quinine has been considered to produce good results, by its influence on the vaso-motor nerves, and its power in retarding tissue-change.

Bleeding has now happily been almost abandoned. The congested livid surface, coma, and stertor, which formerly suggested it, are not now so treated. There are cases in which it may still be practised with advantage; but they are the exception and not the rule. In cases where venesection has appeared first to give relief and mitigate the symptoms, the improvement has been often transient, and been followed by relapse into a more dangerous condition, which has terminated fatally. At the same time no absolute rule can be laid down in this disease with reference to the abstraction of blood; and it is quite possible that greater immediate danger to life may exist in an over-distended right heart than in the loss of an amount of blood which might have tided the patient over that state of peril. Each case must in this respect be treated on its merits. The treatment generally consists in the judicious use of cold, either by affusion or by the application of ice to the surface; the reduction of temperature being watched with a thermometer in the axilla, mouth, or rectum.

Care should be taken not to continue the cold application too long, as danger arises from depressing the temperature below the normal standard. The bowels should be relieved; and blisters may be applied to the calvaria and neck.

In the epileptiform convulsions that occur so frequently, the inhalation of chloroform or of ether may be of benefit, but their administration must be carefully watched. The earliest and

most severe symptoms having subsided, the febrile condition that follows is treated on ordinary principles—salines and aperients being given, but not to the extent of depressing the patient. The diet must be carefully regulated, and be of the blandest and most nourishing nature.

As improvement progresses, other symptoms may supervene, indicative of intra-cranial mischief. Where they are indicative of meningitis, iodide of potassium and counter-irritants may be used with advantage. Removal to a cooler climate is essential. As a general rule, it is desirable that the sufferer should not, for a long period at least, return to a hot or tropical climate; and he should be guarded against all undue exposure to heat, work, or mental anxiety of any kind.

The sequelæ of sunstroke are frequently from such causes most distressing, rendering the patient a source of suffering to himself and of anxiety to his friends.

The less severe symptoms—those, probably, indicative of the slighter forms of meningitis, or of abnormal change of the brain or nervous system—occasionally pass away after protracted residence in a cool climate; but they not unfrequently also cause much suffering, and shorten life. As they point to permanently disturbed, if not structurally injured, cerebro-spinal centres, the treatment required is as varied as the symptoms presented. JOSEPH FAYRER.

**SUPPOSITORY** (*suppono*, I place below). SYNON.: Fr. *Suppositoire*; Ger. *Stuhlzäpfchen*.—A suppository is a solid mass, which is introduced through the anus into the rectum for certain therapeutic purposes. The material of which it is made should be capable either of being dissolved, or of melting at the temperature to which it is exposed in the rectum. Suppositories are *simple* or *medicated*. The former may be exemplified by pieces of soap or tallow-candle, which are popularly used as suppositories. The British Pharmacopœia recognises seven medicated suppositories; and they are cast into moulds of a conical or pastille shape, so as to facilitate their introduction into the bowel. It may be well to give a list of these officinal preparations, according to the following plan, with the proportions of their active ingredients:—

1. Suppositories made with white wax, oil of theobroma, and benzoated lard, each weighing 15 grains:—(1) S. Acidi Tannici, 3 grains; (2) S. Hydrargyri, 5 grains of mercurial ointment; (3) S. Morphiæ, ½ grain of hydrochlorate of morphia; (4) S. Plumbi, 3 grains of acetate of lead and 1 grain of opium.

2. Suppositories made with glycerine of starch, curd soap, and starch:—(1) S. Acidi Carbolici cum Sapone, 1 grain of carbolic acid; (2) S. Acidi Tannici cum Sapone, 3 grains of tannic acid; (3) S. Morphiæ cum Sapone, ½ grain of hydrochlorate of morphia.

Besides these officinal suppositories, others are often prepared and used, containing belladonna and other agents; and the practitioner may employ many drugs in this way with advantage, according to his own judgment.

APPLICATION.—A suppository must be introduced well into the rectum, beyond the sphincter ani. At first this should be done by the practitioner, or by a competent nurse; but subsequently many patients learn to use suppositories themselves without any difficulty. The suppository should be oiled and passed in gradually and gently, without any undue force. It may be necessary to keep the finger applied for a moment, until the tendency to expulsive action on the part of the rectum has subsided.

USES.—A suppository may be used for the following purposes:—(1) As a mere aperient, by exciting the expulsive action of the bowel through local irritation, which also has a reflex effect upon the intestine above. (2) On the other hand, to subdue excessive action of the bowel, and thus check diarrhœa. (3) To bring medicinal agents in contact with the rectum in a suitable form, in order to affect some local disease. Astringents may be thus used. (4) To influence adjacent organs, the active ingredients of the suppository being absorbed. For instance, a morphia suppository will often produce a marked effect upon the bladder and generative organs. (5) To produce the general effects of a drug upon the system. This of course occurs only after absorption, and may be exemplified by the effects of morphia or mercury.

FREDERICK T. ROBERTS.

**SUPPRESSION.**—The complete stoppage of a natural secretion or excretion, such as the urine; or of a normal discharge, as of the menses. The word is used in contradistinction to *retention*, which signifies that these fluids merely remain in the body unexpelled.

**SUPPURATION.**—The formation of pus. *See* ABSCESS; and INFLAMMATION.

**SUPRA-RENAL CAPSULES, Diseases of.**—SYNON.: Fr. *Maladies des Capsules surrénales*; Ger. *Krankheiten der Nebennieren*.

Of the morbid conditions of the supra-renal bodies by far the most important is that connected with Addison's disease, which is described separately. *See* ADDISON'S DISEASE.

Other morbid changes producing neither pigmentation nor asthenia, belong to two categories, namely (1) those beginning *within*; and (2) those originating *without* the supra-renal bodies. Some of the latter may, however, give rise to the symptoms of true Addison's disease, as when the mischief seems to begin in caries of the spine, and ends in the characteristic form of supra-renal changes commonly associated with that malady. The bodies may be otherwise extensively diseased, and yet no special pigmentation and no special asthenia make their appearance. Thus there may be the usual *anomalies of development*, amounting even to what has been called total absence, but this probably depended on defective examination. Certainly the bodies may be *hypertrophied*. Both the organs themselves and their coverings are liable to *inflammation*, especially if the structures connected with the kidney be likewise attacked, and the process spread from them. They may also be the seat of various forms of *degeneration*, but here again we are on doubtful ground, for the earliest change in the bodies in Addison's disease is what was

invariably called by the older pathologists *lardaceous*, whilst the secondary change is a form of *fatty degeneration*. With regard to *tubercle*, some authorities would have the anatomical change in Addison's disease to be of this nature. *Cysts* sometimes occur, but the exact mode of their origin is not quite clear. They may be compensatory, like one variety of emphysema, or they may be destructive.

We are on surer ground when we speak of *hæmorrhage* and *malignant disease*. One case of what may fairly be described as *thrombosis* is reported by Klebs from Lücke's *clinique*. There can be no doubt about the not unfrequent occurrence of hæmorrhage, however arising. Neither is there any question as to the existence of malignant disease in certain cases, sarcoma being more common than carcinoma; but in most cases these do not originate within, but without, the supra-renal bodies. As a rule, all these changes give rise to no characteristic symptoms during life; and are either accidentally discovered after death, or by careful clinical search. The important point to bear in mind is that not one of them gives rise to the symptoms of Addison's disease.

ALEXANDER SILVER.



**SURGICAL KIDNEY.**—DEFINITION.—This term, although open to many objections, may be conveniently employed to group together the various morbid conditions which arise in the kidney as the result of diseases of the lower urinary tract.

PATHOLOGY.—Diseases of the lower urinary tract react on the kidney in three ways:—(*a*) by obstructing the passage of urine, and so causing abnormal tension throughout the whole urinary tract above the obstruction; (*b*) by causing repeated disturbances of the circulation in the kidney, through the medium of the nervous system; (*c*) by decomposition of the secretions spreading from without to the bladder, and extending to the pelvis and even into the tubules of the kidney.

(*a*) Obstruction to the free passage of urine may occur in the ureters from congenital malformation; from impaction of a calculus; or from pressure of a tumour growing in the neighbourhood. It may occur at the vesical orifice of the ureter, from the thickening of the wall of the bladder in hypertrophy; from the thickening and induration of the submucous tissue, and the swelling of the mucous membrane in chronic cystitis; or from the growth of villous or cancerous tumours round the orifice. Obstruction of such a nature as to cause secondary renal affection also occurs in any disease in which the bladder is unable to empty itself, and is consequently in a permanent state of greater or less distension, as in hypertrophy of the prostate or atony of the bladder. Stricture of the urethra and stone in the bladder cause obstruction at the vesical orifices of the ureters, by the chronic cystitis to which they give rise. There is no reason to believe that the valvular orifices of the ureters ever become incompetent, so as to allow of regurgitation from the bladder to the pelvis of the kidney. The only force concerned in producing the remarkable degree of dilatation so often met with in the ureter and pelvis of the kidney is the force of secretion. The abnormal tension thus produced extends, therefore, equally from the point of obstruction to the closed extremities of the urinary tubules.

(*b*) Diseases or injuries causing irritation of the lower urinary tract, especially of the trigone of the bladder and the prostatic, membranous, and bulbous portions of the urethra, react on the kidney in a reflex manner, through the medium of the nervous system. The effect produced is a disturbance of the renal circulation, probably a temporary arterial contraction with anæmia, followed by dilatation with hyperæmia. Such disturbances tend to aggravate any inflammatory process which may be going on in the kidney as the result of other sources of irritation. If the kidney be already much diseased, the circulation may become completely arrested by choking of the vessels during the stage of hyperæmia, and total suppression of urine may result, terminating in some cases fatally. The evidence of this reflex disturbance of the renal circulation is derived from the following facts. 1. Many cases have been recorded of death from total suppression of urine occurring as a consequence of operations involving some mechanical irritation of the parts above mentioned. In such cases the kidney has always been found intensely congested. 2. It is a matter of common surgical experience that operations on the urinary organs frequently prove fatal by inducing acute inflammation of the kidneys. This is (as will be presently shown) often the result of the introduction of the causes of decomposition into the bladder, followed by extension of decomposition to the kidney. But cases frequently occur in which the patient before the operation was suffering from cystitis, with putrid urine, and had been so suffering for some time, and in these it is evident that the final acute attack is the direct result of the irritation of the operative procedure. 3. By direct observation of the urine passed after such an operation as forcible dilatation of a stricture, evidence of a disturbance of the renal circulation may be obtained. In the most typical cases there is temporary suppression of urine, probably corresponding to a period of anæmia of the kidney, with contracted vessels. This may last from one to three hours. It is followed by a gradual increase in the quantity of urine, which now frequently becomes uniformly tinged with blood, the amount of blood often increasing for some hours, and then slowly diminishing. This blood cannot be supposed to flow at so late a period from a lacerated wound, such as is produced by forcible dilatation; it is uniformly mixed with the urine, and free from clots. The presumption is, therefore, that it comes from the kidney. In most cases the period of suppression is too short to be noted, and in others an immediate increase in the flow of urine has been observed. The rigor which frequently occurs within a few hours of an operation on the lower urinary tract is, in many cases, doubtless due to this disturbance of the renal circulation.

(*c*) The final fatal inflammation of the kidney is, in most cases, due to extension of decomposition of the urine from the bladder to the pelvis and kidneys. The balance of evidence is now so greatly in favour of the view that decomposition

of urine is due in all cases to the introduction of microscopic organisms from without, that it may be almost looked upon as definitely proved. These organisms may find their way into the bladder, either by being carried thither by instruments introduced by the surgeon, or by spreading inwards by multiplication in the layer of ropy mucus or other discharge which adheres to the walls of the urethra in acute inflammation of the bladder, in chronic cystitis accompanying stricture or stone, in gonorrhœa, or injury. As no regurgitation takes place in any case from the bladder to the ureters, the decomposition may remain long limited to the bladder, but when, from the other sources of irritation, a catarrhal condition of the pelvis of the kidney is induced, ropy threads of mucus come to lie with one end in the ureter and the other in the foul bladder, and by means of these the organisms find their way into the ureter, and there multiplying may extend far into the kidney-substance. In such cases the microscope frequently shows the tubules of the pyramids completely plugged with micrococci. The effects produced by the extension of putrefaction to the kidney will be described with the form of kidney it gives rise to.

Anatomical Characters.—There are four forms of renal affection which may result from the foregoing sources of irritation.

I. *Chronic interstitial inflammation, followed by absorption of the medullary portion, and later on by stretching and thinning of the cortex, without pyelitis.*—This condition is the uncomplicated effect of obstruction to the free flow of urine and of the consequent increased urinary pressure. It is most frequently met with in cases of pressure on the ureter from without. In diseases of the bladder and urethra it is almost always complicated by an acute attack of interstitial inflammation, which is the immediate cause of death, and which more or less conceals the appearances about to be described. In the early stage there is slight dilatation of the ureter and pelvis of the kidney. The kidney itself is increased in size; the capsule separates without difficulty, but may leave the surface somewhat wanting in its natural smoothness. The venous stars on the surface are often clearly marked, the cortical substance being of a pale pinkish white or sometimes yellowish colour. On section the cortex is found to be wider than natural; sometimes considerably so. The medullary portion is usually pale, like the cortex, but the large veins at the cortico-medullary junction are often distended with blood. The kidney-substance is tougher than natural. The Malpighian bodies can usually be clearly seen, sometimes as red dots. Microscopic examination shows an overgrowth of the interstitial connective tissue. Between the tubules, and especially around the Malpighian bodies, are crowds of small round cells. In consequence of this new growth, the kidney is somewhat squeezed within its capsule, and as soon as the heart's action ceases the smaller vessels empty themselves. Hence the distended condition of the veins, and the anæmic appearance of the cortex. The epithelium shows no change. The next stage observed is commencing absorption of the medullary portion; the ureter, pelvis, and calices become still more distended; the papillæ are first flattened, and then the pyramids become hollowed out. This is a process of pure absorption, there being no ulceration. The cavity formed by the dilated calyx, and the hollow left by the disappearance of the pyramid, are lined by a continuous smooth layer of opaque white mucous membrane. In the final stages the cortex in its turn becomes thinned and stretched, until at last the whole kidney may be dilated into a large sac, one side of which is smooth, being formed by the thickened walls of the dilated pelvis, and the other is deeply sacculated, each sacculus corresponding to a lobe of the kidney. On this side the wall is formed of the thinned and stretched cortex, sometimes no thicker than a shilling, to which the capsule, now thickened and opaque, is firmly adherent. In the later stages the microscope shows the same abundant small-cell infiltration, with the development of a greater or less amount of fibroid tissue. The Malpighian bodies show marked changes. The capsules, instead of being delicate and membranous in structure, become greatly thickened, apparently by dense fibroid tissue formed round them in concentric layers. As this change progresses the vessels may become strangulated and finally obliterated, and the corpuscle then shrivels, and comes to be represented by a circular body almost homogeneous in the centre, but marked by a few curved lines indicating the situation of the obliterated vascular tufts. Round this centre is a concentrically laminated layer, formed by the thickened capsule. Even in the most advanced stages the epithelium of the convoluted tubules shows remarkably little change beyond being somewhat flattened.

If at any stage obstruction to the free flow of the urine be removed the process ceases. The new tissue between the tubules undergoes development into dense fibroid tissue, the process being accompanied by great contraction. The kidney, from being increased in size, may thus become much smaller than natural, excessively tough and puckered, and irregular in form. If the distension have reached the most extreme stage before the primary disease is relieved, the kidney may come to be represented merely by a small nodule of dense fibroid tissue.

II. *Acute diffuse interstitial nephritis without suppuration.*—In this variety both kidneys are usually affected. The kidney is increased in size, and the surrounding fat is sometimes œdematous and adherent to the capsule. When removed the capsule separates without difficulty, but often leaves the surface coarse; it is somewhat opaque, and often marked with ramifying vessels. The surface is usually of a pale, yellowish-white colour, often mottled with dark red, or in some cases the red may greatly predominate. The mottling often corresponds to the bases of the lobules of the gland, some of which are paler than others, in consequence of the more advanced condition of the interstitial inflammation. On section the cortex presents the same colour and mottled appearance as the surface, and is evidently swollen. The pyramids may be pale, but are often dark red, contrasting strongly with the paler cortex. The Malpighian bodies are usually clearly visible, and may show on the cut surface

as red dots. The consistence of the kidney-substance is unnaturally soft, unless previous to the acute attack it has been indurated by the chronic process first described. The pelvis may be merely dilated, its mucous membrane opaque, and its contents free from decomposition, but more commonly it is marked by ramifying vessels, and presents evidence of chronic congestion, in pigmentation and thickening with induration. In other cases it is intensely injected, and sometimes covered with a membranous exudation mixed with phosphatic deposit. In these cases the urine and mucus it contains are in a state of decomposition. In consequence of the pallor of the kidney sometimes met with as a result of the emptying of the vessels after death, this form of kidney may, without the microscope, be confounded with the large white or the fatty kidney.

On microscopic examination the following conditions are found. Between the tubules is a very abundant accumulation of small round cells. These are especially abundant round the Malpighian corpuscles. So far it is merely an intensification of the condition described as resulting from increased urinary pressure. The change is not uniform; every field of the microscope varies. In one part the renal structure may appear almost normal, and close by the new cells may be heaped up to such an extent as nearly to conceal the tubules. In the pyramidal portion a similar condition is met with. The renal epithelium throughout is slightly more cloudy than natural, and somewhat swollen, but the nuclei of the cells are readily to be seen in sections prepared in the ordinary way. The adhesion of the epithelium to the membrana propria is somewhat lessened, so that unless considerable care be taken it will wash out in preparing the specimen. Fibrinous casts may be seen here and there in the tubules, and occasionally small round cells resembling those outside the tubule may be seen within it. Signs of previous chronic change are often met with, such as dilatation of some of the straight tubules, and obliteration of some of the Malpighian corpuscles.

III. *Acute interstitial nephritis with scattered points of suppuration.—Suppuration of the kidney, Suppurative nephritis, or, when accompanied by pyelitis, Pyelo-nephritis (Rayer); Uroseptic kidney (Dickinson); Parasitic kidney (Klebs).*—This form of surgical kidney is by far the most common. It is the usual cause of death in fatal cases of disease of the bladder or urethra, in which putrefaction of the contents of the bladder has occurred. It thus comes to be one of the most common fatal complications in cases of injury or disease of the spinal cord, with paralysis of the bladder. It has been frequently stated that it is invariably associated with putrid urine in the pelvis of the kidney and septic pyelitis; but cases are undoubtedly occasionally met with in which the condition is well-marked, and yet the pelvis is free from inflammation, and its contents are healthy. The naked-eye appearances of acute suppurative nephritis are the following. The surrounding fat may be œdematous and unnaturally adherent to the capsule. The whole kidney is considerably swollen, and its substance soft. The capsule is opaque and thickened, and marked by fine ramiform injection. It separates easily, but tears the kidney-substance in so doing. As it peels off, yellowish-white spots, surrounded by a red zone, come into view. Some of these are minute drops of pus escaping from the small abscesses as the capsule is stripped off, others are on the point of breaking down into pus, but are still solid. These abscesses are grouped together in areas corresponding to the bases of the lobes of the kidney. If the veins can be recognised, the abscesses will often be seen to correspond to the points at which the interfascicular veins appear on the surface. On section the cortex is seen to present much the same appearance as in the last form of kidney, but in addition yellowish streaks are seen passing from the points of suppuration deeply into the cortex, and often into the medullary portion. These streaks correspond to the course of the interfascicular vessels. They differ from embolic infarcts in their great length compared to their breadth. The pelvis is usually in a condition of most intense inflammation, and the mucous membrane is often covered with a layer of exudation mixed with phosphates. Its contents, composed of urine, blood, and mucus in a state of decomposition, are excessively foul. Cases, however, do occur in which a similar condition of suppuration in the kidney is met with without pyelitis.

Occasionally the kidney is found to be surrounded by a large abscess, arising from a perforation of the pelvis. More frequently one of the superficial abscesses in the cortex bursts beneath the capsule, and gives rise to a large collection of pus separating the capsule from the kidney.

The microscope shows the small-celled infiltration between the tubules in a still more intense form than in the varieties before described. In the areas of suppuration the kidney-substance has entirely disappeared, and its place is occupied by leucocytes packed closely together. In the central parts of these accumulations of small round cells the intercellular substance has softened, and the formation of pus has taken place. The amount of general interstitial change varies considerably; sometimes between the areas of suppuration the kidney-substance is almost healthy, in other cases there is a very marked general interstitial inflammation. The epithelium appears to take no part in the formation of the new cells. It is cloudy and swollen, but undergoes no proliferation. In the straight tubules it is often found to have been thrown off. Many of the tubules, even in the convoluted part, are found choked with micrococci. Klebs describes these as entering into the epithelium, and subsequently finding their way into the intertubular lymph-spaces, where he believes they cause the interstitial inflammation and suppuration. This has not been confirmed by other observers, but it seems highly probable that the micrococci do play an important part in causing the inflammation. Possibly the exact part they take may be more clearly demonstrated by the improved methods of observation lately introduced. It may safely be affirmed that wherever they are to be seen immediately after death, septic processes were taking place during life, and it is highly probable that even if they do not them-

selves pass out of the tubules, the septic products they give rise to soak out into the lymph-spaces, and thus cause a diffuse inflammation of the intertubular tissue. The lines of inflammation, as before stated, follow the course of the interfascicular veins, and the lymphatics also follow the same direction. In the pyramidal portion thrombosis of the small veins is occasionally met with, but this is probably merely secondary.

If such an acute condition as is above described be set up in a kidney already altered in form by dilatation from increased urinary pressure, the appearances will, of course, correspondingly differ.

IV. *The cicatricial kidney.*—This is the result of recovery from one of the preceding conditions, probably only from one or both of the first two, as, if the disease reach the stage of suppuration, the patient is hardly likely to survive. The kidney is shrunken, irregular in form, and marked by deep cicatrices. The substance is excessively tough, and the capsule firmly adherent. Small cysts may be scattered through its substance, which are supposed to result from strangulation of the tubules. The microscope shows a great excess of dense fibroid intertubular substance, and numerous obliterated glomeruli are met with.

The varieties of kidney here described may be combined in various ways. Thus a dilated kidney may suffer from acute diffuse interstitial inflammation, with or without suppuration; or a cicatricial kidney may, from a return of the primary disease, again suffer from an acute attack. It seems probable that increased urinary pressure, combined with considerable reflex irritation, is quite sufficient to give rise to a degree of interstitial nephritis which is incompatible with life, and may possibly even culminate in suppuration. The extension of decomposition of urine from the bladder to the pelvis of the kidney is alone a sufficient cause for disseminated suppuration of the kidney; but both the extension of decomposition and its more serious consequences are greatly predisposed to by the effect produced on the kidney by the two first causes of irritation; in fact, it is comparatively rare to meet with cases in which septic suppuration occurs in a kidney previously perfectly healthy.

Symptoms.—Simple chronic insterstitial inflammation, with dilatation of the kidney from increased urinary pressure, gives rise to but few symptoms, and is very difficult to recognise. The most important signs are, that the quantity of urine secreted is increased, and its specific gravity lowered. To avoid error, the whole urine passed in twenty-four hours should be collected, and the specific gravity taken. Single observations are open to numerous fallacies. There may be a trace of albumin, or it may be entirely absent. In one very marked case discovered after death at University College Hospital, the urine had a specific gravity of 1·009, and was free from albumin. A few hyaline casts may be present, but they are by no means constant. The exact state of the urine is often concealed by the mucus, blood, and pus from the lower urinary tract. It is surprising how much urine is secreted by a kidney which is reduced to a mere sac, with no pyramids and a cortex no thicker than a shilling. In a case that came under the observation of the writer, there had been no diminution in the secretion, and the specific gravity was 1·008. In some cases the distended kidney may be recognised by palpation, but this is not common. There are, in fact, no definite symptoms, either subjective or objective, accompanying this form of renal disease. It is not accompanied by hypertrophy of the heart, nor by marked increase of the arterial tension.

Subacute interstitial nephritis gives rise to more marked symptoms. It runs an irregular course, often lasting for weeks or even months, and terminating either in recovery or in a final acute attack with suppuration. If the disease arise as the direct result of some operation on the lower urinary tract, its commencement is usually marked by a rigor; in other cases it comes on more gradually, with frequent chills but no actual rigor. The temperature is high at night, reaching 101° to 102° Fahr., but it falls towards morning, so that if it be only taken at that time, the elevation may be completely overlooked. The patient becomes weak and languid, and emaciates rapidly. He loses appetite, and there may be nausea or occasional vomiting. There may be diarrhœa, but this is by no means constant. The mouth becomes clammy, and the tongue foul, with a tendency to dryness. In severe cases the tongue becomes dry and brown, and sordes form on the teeth and lips. The skin is usually moist and clammy, and there is not the dryness so frequently met with in other forms of renal disease. There is no œdema. In some cases the swollen kidney may be felt by palpation in the loin, and tenderness may be elicited on deep pressure, but this is by no means constant. The patient may complain of pain in the lumbar region, but this symptom is of little value, as it is often absent, and may arise from many other causes than renal disease. The pulse presents nothing characteristic. The patient frequently sinks into a drowsy state, somewhat resembling the effect of an overdose of opium, but true coma is rarely, if ever, present, and convulsions never occur. The urine is passed in fair quantity, often in excess of the normal amount. The amount of albumin is never very great, but it is usually difficult to estimate accurately how much is renal, and how much is derived from blood or pus from the lower urinary tract. Microscopic examination may show hyaline casts, or occasionally pus-casts; renal epithelium is also frequently met with; but all microscopic examination is rendered difficult by the presence of mucus and pus from the lower urinary tract. If the primary disease either be removed or relieved by treatment, the symptoms gradually subside; if not, they remain without much change till the patient gradually dies exhausted, or an acute attack rapidly leading to suppuration of the kidney puts an end to the case.

Acute interstitial nephritis with suppuration most frequently forms the fatal termination of the variety of disease just described, but it may occur without any previous symptoms. The invasion is marked by a severe rigor, often occurring within a few hours of some operation on the lower urinary tract. The rigor is accompanied by great elevation of temperature, and followed

by profuse perspiration, during which the temperature falls, perhaps below normal, but it soon rises again, and remains slightly raised, with evening exacerbations. The rigor may be repeated during the progress of the case at irregular intervals. The general symptoms resemble in every respect those just described as indicative of subacute interstitial nephritis, but they are increased in intensity. The strength rapidly fails, there is great emaciation, the pulse becomes feeble, and the tongue 'like a piece of broiled ham.' There may be occasional vomiting and diarrhœa. As the fatal termination approaches, the temperature falls often considerably below normal, the skin becomes cold and clammy, and the patient sinks into a drowsy condition, seldom deepening into actual coma. Although the patient is often said to be dying of 'uræmia,' there are none of the uræmic symptoms observed in acute Bright's disease. There are no convulsions or actual coma, and no œdema. The urine is usually so foul as to defy accurate examination, either chemically or by the microscope. It is secreted in fair quantity to the end of the case. Pus and blood are always found in it, but it is impossible to say whether they come from the kidney or from the lower urinary tract. Renal epithelium and pus-casts are occasionally met with.

It will be seen from the above description that the symptoms closely resemble those of septicæmia, and it is very probable that blood-poisoning, from absorption of the putrid matter in the pelvis of the kidney and lower urinary tract, is, in fact, an important factor in the disease.

*Suppression of urine* following operations on the lower urinary tract is a well-recognised, but fortunately rare, cause of death. In such cases the kidney is always found to be intensely gorged with blood, and the microscope reveals the signs of previous chronic interstitial inflammation.

*Urethral fever* is a name given to the febrile disturbance, accompanied by a rigor, which so often follows operations on the lower urinary tract. It is impossible to discuss here the innumerable theories which have been put forward from time to time to explain its origin and nature. It is most probable that it is due to a passing congestion of the kidney arising as a reflex phenomenon, as described in the earlier part of this article.

Diagnosis.—As before stated, the diagnosis of the more chronic secondary renal conditions is frequently impossible. A careful observation of the case for a few days will usually suffice to determine the presence of subacute consecutive renal inflammation. The acute form with suppuration may resemble *pyæmia*. From this it may be distinguished by the absence of secondary inflammations in the joints, subcutaneous tissue, and lungs; by the lower temperature, falling towards death; and by the early and excessive dryness of the tongue. Pains 'all over the body' are often complained of in pyæmia, while in suppurative nephritis the patient is usually free from pain, except such as may arise from the local disease. With the greatest care in observation, however, the diagnosis may remain doubtful till death. From *septicæmia* it often cannot be distinguished, for doubtless blood-poisoning from absorption of the putrid matter in the kidney is an important element of the disease in many cases.

Prognosis.—This depends, in the chronic or subacute form, entirely upon the possibility of removing or relieving the primary disease. After suppuration has commenced in the kidney, it is very doubtful if recovery ever takes place. If decomposition has extended from the bladder to the pelvis of the kidney, the patient's chance of recovery is much reduced. It is sometimes possible to ascertain this in the following way. Wash out the bladder carefully with diluted Condy's fluid until the solution as it comes out of the bladder retains its purple colour. Then leave the catheter in for a few minutes, and examine the first drops that flow from it. If these are clear and acid, it is evident that the decomposition is still limited to the bladder.

Treatment.—The most essential element of the treatment is to remove the cause if possible, but the act of doing so is seldom unaccompanied by the danger of increasing the disease, involving, as it often does, severe operations upon the urinary organs, as lithotomy, lithotrity, internal or external urethrotomy, &c. These operations would of course, if possible, be avoided if the renal symptoms were at all marked. The fatal termination being in almost all cases associated with putrefaction of the urine in the bladder, and extension of the putrefactive process to the pelvis of the kidney, it is needless to point out that our best hope of preventing consecutive renal inflammation lies in the prevention of decomposition in the bladder, by scrupulous attention to cleanliness in the instruments used. This cannot be too much insisted upon in the management of cases of paralysis of the bladder from injury or disease of the spinal cord. Actual cleanliness can only be obtained by the use of antiseptics. For this purpose all catheters should be washed in some powerful antiseptic lotion, and when used should be greased with carbolic oil (1 to 10) or some other antiseptic preparation. Perhaps the best preparation is that recommended by Mr. Lund, composed of carbolic acid, 1 part, castor oil, 4 parts, olive oil, 12 parts. If decomposition should occur in the bladder, antiseptic lotions must be injected, in order, if possible, to restore the healthy condition before extension has taken place to the kidneys. The best solutions for this purpose are quinine, gr. iij; dilute sulphuric acid, ♏iij, water ad ℥j; Condy's fluid, ℥j ad ℥x; and thymol solution (saturated). Carbolic acid is rather too irritating, as also is chloride of zinc.

If the symptoms of subacute interstitial nephritis are present, the patient will frequently derive much benefit from a pure milk diet. At the same time small doses of opium seem to promote the action of the skin, and so to relieve the kidney without producing the dangerous effects so much to be feared in Bright's disease. The action of the skin may at the same time be still further promoted by vapour baths. The bowels should be kept freely open. Counter-irritation, either by dry-cupping or mustard poultices over the loins, followed by hot fomentations, is frequently of use. If the urine is foul it may be greatly improved by the adminis-

tration of benzoate of ammonia or benzoic acid in ten-grain doses every six hours. When the symptoms of the acute form are well-marked, operations to relieve the cause only hasten the fatal event. By careful nursing, and the treatment above described, the symptoms may be so far reduced in intensity as to render an operation for the removal of the cause justifiable.

MARCUS BECK.

**SWEAT GLANDS, Diseases of.**—*See* SUDORIPAROUS GLANDS, Diseases of.

**SWEATING, Disorders of.** *See* PERSPIRATION, Disorders of.

**SWELLING.**—SYNON.: Fr. *Gonflement*; *Tuméfaction*; Ger. *Schwellung*.—This term, when employed in medicine, is applied both to the process and to the condition of increase in volume of any part of the body. In a small number of instances swelling is a normal process, and may be periodical; for example, the swelling of the mammæ at puberty, during menstruation, and in pregnancy; of the uterus during gestation; and of the penis during erection. As a rule, however, swelling is a morbid process or condition, and many examples of it are afforded by disease. These may be broadly classified as—(A) *Local* or *circumscribed*; and (B) *General* or *diffused* swelling.

(A) *Circumscribed.*—The most important varieties of this kind of swelling are:—1. Simple *hypertrophy*, as of the thyroid gland in some forms of goître; 2. Swelling due to *disorders of the circulation* or *inflammation*, as in congestion of mucous membranes, and in ordinary abscess; 3. *Œdema*, and certain other rarer exudations into the connective tissues; 4. *Extravasations* of blood, urine, gas, and other products; 5. *Dilatation* or *distension* of natural cavities or vessels, as of the serous sacs and joints by effusions of any kind, of the stomach and bowels by gas, of an artery in aneurism, and of the jugular veins in tricuspid disease; 6. *Disturbed relations* of parts, as in dislocation of the joints, and in hernia; 7. *Retention* and *accumulation* of natural secretions and excretions, as of urine in the bladder, and fæces in the bowels; and 8. *New growths* or tumours proper, including cysts and parasites. Inflammatory enlargements and new growths constitute by far the most common causes of local swelling.

(B) *Diffused.*—Infiltrations of the subcutaneous connective tissue constitute the principal varieties of swelling that fall under this head. Such are anasarca, myxœdema, general emphysema, and the much more uncommon cases of general swelling of the body which result from the stings of certain plants and animals, and the use of poisonous food.

'*Cloudy swelling*' is a term applied in morbid histology to a condition of the cell in which it appears at once enlarged and finely-granular, as in parenchymatous degeneration or inflammation (*see* DEGENERATION). '*White swelling*' (*tumor albus*) is a popular synonym for scrofulous disease of a joint, usually of the knee.

The *treatment* of swelling depends entirely upon its cause. J. MITCHELL BRUCE.

**SWINE-POX.**—A form, possibly, of modified small-pox, in which the pock completes its development imperfectly. It forms a pustule, but the pustule neither umbilicates nor maturates. Willan termed this kind of pock *varicella globularis*; whilst popularly it has also been called 'hives.' *See* CHICKEN-POX.

**SYCOSIS** (σῦκον, a fig).—SYNON.: *Mentagra*; Fr. *Sycose*; Ger. *Feigwarzenflechte*.

DEFINITION.—A folliculitis affecting the hair-follicles of the face, and particularly those of the chin and whiskers.

ÆTIOLOGY AND PATHOLOGY.—The most frequent cause of sycosis vulgaris is a cold temperature: we meet with it usually after the patient has been exposed to inclement weather. But any other cause, whether local or constitutional, capable of setting up inflammation in those very important cutaneous structures, the follicles, and especially the follicles of the larger hairs, may be an excitant of the disease. It has been assumed that the hairs may have some share in keeping up the disease; but we must recollect that the seat of the pus-formation is the subepithelial surface of the true skin, and consequently that the hair is not bathed in the pus, but is separated from it by the epithelium. The microscope has shown that those phytiform cell-structures which are to be met with wherever epithelium is in a state of softening and decay, and which have been spoken of as parasitic fungi, are present in the softened epithelium of the follicles in this disease; and the opinion has been ventured that the disease may be of a parasitic character, and therefore contagious. And just as the disease is supposed to originate sometimes in the use of a bad razor, so also it has been assumed that the disease may be propagated by shaving. Indeed the term *sycosis contagiosa* has been applied to it under this suspicion. *See* TINEA.

DESCRIPTION.—Sycosis is known by the presence of a crop of pustules, each perforated by a hair, and more or less acuminated, developed on a ground which is red and inflamed, and more or less swollen and infiltrated. The pustules break and form prominent crusts; and a successive crop of pustules makes its appearance every day, thus prolonging the disease for weeks, months, and even years. Essentially the disease is an inflammation of a chronic and aggravated character; and is attended with burning heat, stiffness, and considerable pain and suffering.

VARIETIES AND COMPLICATIONS.—Sycosis may be simple—*sycosis vulgaris*—and vary only in degree; or it may be complicated with lupus erythematosus. The former will present a variety of appearances referable to the constitution of the patient, or to the care or neglect of the disease. When neglected, the crusts will accumulate amongst the hairs, and increase the local irritation; so that the integument may be projected in the form of hard tubercular masses, by the Latins called *fici*, and by the Greeks σῦκα; and a veritable sycosis may be the consequence. In this way a mild form of the disease would be a mentagra, and a severe form a sycosis.

The lupoid form of the disease is accompanied by atrophy of the papillary layer of the skin;

the elimination and destruction of the hairs, and the production of cicatricial tissue, which converts the diseased part into a huge scar, either perfectly smooth, or roughened by an interlacement of bands of white fibrous tissue.

Diagnosis.—The diagnosis of sycosis is self-evident; no other affection of the skin answers to the definition of a pustular inflammation of the hair-follicles, limited to the hairy regions of the face.

Prognosis.—Sycosis is obstinate and troublesome, even in its mildest forms; whilst its more severe or more chronic forms are apt to last for months, or even years. The lupoid variety has all the tediousness of lupus erythematosus superadded to the follicular disease.

Treatment.—Whenever any derangement of general health can be detected, this must receive our considerate attention; but very constantly the disease is unaccompanied by symptoms of disorder of constitutional function, and we are constrained to rely chiefly on local treatment. In the earlier stages or more acute forms of the affection the local treatment should be *palliative*; and in a chronic stage *stimulant* in various degrees. Fomentations with decoction of poppy-heads, water-dressings, and especially cold starch poultices, relieve the heat and local suffering, and are extremely beneficial. In less severe cases the cold starch poultice, which consists of starch (without blue) made in the usual way and allowed to cool, may be applied at night, and the oxide of zinc ointment or calamine ointment during the day. The acetate of lead ointment is likewise very useful in some cases. Considerable benefit is also obtained by epilation of such of the hairs as are loosened by the suppuration of the follicles.

In chronic forms of the disease the iodide of sulphur ointment, diluted with two-thirds of benzoated lard or vaseline, is an excellent remedy; so likewise are ointments of the yellow and red oxides of mercury; while in the lupoid forms of the affection, pencilling the congested portions of the skin with the liquor plumbi is to be preferred.

Erasmus Wilson.

**SYMMETRY, in Relation to Disease.**—Certain diseases and degenerations manifest themselves in changes of structure which are arranged symmetrically in correspondence with the symmetrical construction of the body. They appear most frequently in bilateral symmetry in corresponding parts of the right and left sides. More rarely, they appear, not only in this bilateral symmetry, but in an arrangement accordant with the homologies of parts in their relations to the longitudinal vertebral axis of the body, as the soles and palms, the knees and elbows.

The most marked symmetry is found in the group of senile degenerations; as in thinning of the hair and baldness, in wasting and wrinkling, and the arcus senilis. It is scarcely less complete in the less simply degenerative changes of atheromatous arteries, and the wasting and increasing fattiness of senile bones. In atheromatous arteries also, the homologous symmetry, as well as the bilateral, is often seen; the changes in the radial corresponding with those in the peroneal, and those in the ulnar with those in the anterior tibial.

Among symmetrical diseases the best examples are seen in chronic rheumatic arthritis or osteo-arthritis, rickets, psoriasis, ichthyosis, pityriasis, neurotic pigmentations, the eruptions of secondary syphilis, and those produced by iodide of potassium and some other medicines or poisons.

Chronic rheumatic arthritis shows the best instances of symmetrical changes coincident in many different structures; for instance, in the fibrous degeneration and wasting of cartilage, the thickening and fringed growths of synovial membrane, the nodular formations on the bones. In psoriasis, whether syphilitic or not, there are often good examples of the coincident homologous and bilateral symmetries.

Instances of symmetrical diseases less marked or less constant than these are seen in the deformities of gouty hands and feet, in the thickenings and contractions of palmar fasciæ, in scrofulous lymphatics of the neck or groin, in scrofulous hands and feet, in many cases of eczema, in symmetrical gangrene, and in cartilaginous tumours of the hands and feet.

Significance.—The chief interest of the study of symmetrical degenerations and diseases is in their illustration of some principles of pathology.

The symmetry of senile degeneration is an indication and result of the exact and perfectly maintained uniformity of bilateral changes occurring in the natural life of each symmetrical body. As the two lateral halves, from the embryo state onwards to the state of fullest vigour, pass through changes which are, in each half, progressive at the same rate and in the same method, so that (speaking generally) the two halves are always alike in size, structure, and composition, so is it in decay or degeneration. From beginning to end of normal life the two lateral halves keep time in their similar and equal changes: the changes which are symmetrical are as exactly synchronous. Thus, the senile or timely degenerations of structures are in accordance with the laws of healthy life; and their uniformity is the more notable because they indicate, as do some symmetrical diseases, that the two lateral halves of the body are more alike in method of life and probably in composition, than they are in size and shape. The corresponding limbs are very often unequal in length and circumference. The difference in the lower limbs is often sufficient to give an appearance of spinal curvature. And in faces exact symmetry is very rare: one eyebrow is commonly higher than the other; the septum of the nose is rarely median; the mouth often not horizontal, especially in emotional movements; or one half of the lower jaw is less nearly rectangular than the other, and that side of the face is the smaller or the more oblique. Yet, in parts thus unlike in shape or size degeneration may appear in perfect symmetry. It is in the exact similarity of composition and method of life, thus shown to exist in corresponding parts of the two halves of the body, that we find the explanation of most of the symmetrical diseases.

In the list of those diseases which has been given, and which includes the best examples of

the group, some may, perhaps, be regarded as instances of 'monstrosity by excess,' deviating very widely from the normal type. Such may be the irregularly symmetrical cartilaginous tumours of the hands and feet. The rest may very probably be ascribed to alterations in the blood or in the nervous force, or in both.

Among the conditions necessary to the normal state and life of each part, are the due relations between it and the nutritive materials supplied to it in the blood. In symmetrical and exactly similar parts these relations are exactly the same; and as the healthy blood equally supplied to any two symmetrical parts enables them to maintain their similarity in health, so an unhealthy blood may produce in them an equal similarity in disease. It may often be impossible to find what is really the morbid condition of the blood in symmetrical disease; but the existence of such a condition is nearly proved in the eruptions produced by iodide of potassium, in many cases of urticaria, in lead-poisoning, and in cases of gouty and syphilitic eruptions.

Similar considerations may show that symmetrical disease is due to an altered state of the nervous force. A certain healthy state of this force is a necessary condition of the healthy nutrition of every part; and as the cerebro-spinal nervous system and the ganglionic nerves associated with it are arranged in a bi-lateral symmetry, so it may justly be held that, as a rule, the nervous force is in all symmetrical parts present in exact likeness. A general disturbance of the nervous force, or any central disturbance transmitted along symmetrically arranged nerve-fibres would, therefore, generate symmetrical disease; and this, whether we believe that there are special trophic nerves and nerve-centres, or that the trophic nervous influence is exercised through some special condition of the vaso-motor or other nerve-fibres. In either, or in any case, as a healthy nerve-force in the parts is a necessary condition of their healthy symmetry, so may or must a morbid nerve-force produce a symmetrical disease.

The instances of such diseases in which the disturbance of nervous force is most clear are the symmetrical gangrenes of fingers, preceded by intense neuralgia, and the neuretic pigment-marks of the face and forehead. It is not yet possible to tell whether the disturbance is of vaso-motor or of trophic influence, or whether (unless in a few instances) it is of central origin, or reflected from some previously existing peripheral disease, or be even due to some affection of peripheral nerves. But the facts of symmetrical diseases are among the chief of those proving the influence of the nervous system in the production and method of organic disease; and they are mutually illustrative with those of unilateral diseases, such as herpes zoster, whose distribution accords with that of certain nerves, whose disturbance is further indicated by neuralgia.

There thus appear to be among the symmetrical diseases some which may be ascribed to morbid states of blood, and some due to morbid states of nerve-force. But it is probable that in yet more, if not in all, both blood and nerve-force are at fault, the latter chiefly determining the localities, the former chiefly the method and obvious characters, of each disease. The phenomena of many of the diseases may be thus explained better than by referring them to only one disturbing force. There are, indeed, few diseases in which the respective shares taken by blood and by nerve-force in morbid processes can be better studied; few, from the study of which we may more justly hope to attain the means of reconciling the often antagonistic doctrines of a humoral and a neural pathology.

JAMES PAGET.

**SYMPATHETIC** (*σὺν*, with; and *πάθη*, feeling).—This term implies that a part or organ suffers in sympathy with some other part or organ which is diseased. Many disorders which seem, and are popularly supposed, to arise in this way can be traced to obvious pathological causes. Thus, a morbid process may extend directly along blood-vessels, lymphatics, or other tissues; or a morbific agent may be conveyed by the blood or lymph from one part to another; or a secondary lesion may be produced by direct nervous influence. There are other cases, however, in which the connection is not so evident, but it is quite intelligible that organs which are physiologically related may be sympathetically disturbed in pathological conditions. The sympathetic disturbance may be indicated by mere pain or other subjective sensation; by functional derangements, as of secretions or actions; or by positive organic lesions. The occurrence of such phenomena in corresponding parts on both sides of the body, when a disease has commenced on one side, is sometimes very curious, especially as regards organic lesions. As illustrative of the associations in which the word 'sympathetic' is employed may be mentioned *sympathetic pain*, *sympathetic headache*, *sympathetic cough*, *sympathetic vomiting*, *sympathetic bubo*.

FREDERICK T. ROBERTS.

**SYMPATHETIC SYSTEM, Disorders of.**—SYNON.: Fr. *Maladies du Nerf sympathique*; Ger. *Krankheiten der Nervus sympathicus*.

INTRODUCTION.—This subject can only be treated in a brief and tentative manner, owing to the fact that a wide basis of positive knowledge does not exist. The physiology of the different departments of the sympathetic system of nerves is now only beginning to shape itself, whilst on the side of pathology and morbid anatomy there is even still less of definite knowledge. Thus it happens that for the most part only conjectures, often very insecurely based, are current, or can be said to exist, in regard to the dependence of definite sets of symptoms, or distinct diseases, upon disordered actions or morbid changes occurring in one or other part of the sympathetic system of nerves. These problems are now, however, receiving the attention of many workers, so that before long it is to be expected that our knowledge on this important subject will have become both more extensive and more definite. We shall, therefore, in the present article, confine ourselves to some general remarks concerning the anatomical relations and the functions of the sympathetic system of nerves; to the modes in which disorders of

its several parts may arise; and to little more than a mere mention of the various morbid conditions, which may be principally or in part occasioned by defective or otherwise abnormal activity of one or other department of this great system of nerves. We shall thus be enabled to indicate some of the best established facts or relations in this direction which have already acquired a clinical importance, and also to indicate the directions in which further advances are to be looked for.

Whilst the sympathetic system of nerves, with its double ganglionated cord and great ganglionic plexuses, is to a certain extent an independent nervous system, its roots nevertheless penetrate deeply into the cerebro-spinal axis. The two nervous systems are connected, on each side of the spinal column, by means of double sets of filaments, passing between each of the sympathetic ganglia and the respective anterior spinal nerves with which they correspond, as well as with most of the nerves attached to the medulla oblongata. The fibres in all these filaments of communication are partly afferent and partly efferent. Thus, just as ingoing or centripetal impressions, instead of being reflected from some of the sympathetic ganglia, may pass on to spinal and medullary centres, so may motor or inhibitory impressions pass outwards from these cerebro-spinal centres, so as to modify the subordinate motor or secretory influences, emanating from some one or other of the sympathetic ganglia themselves.

From the ganglionated cord on each side of the spinal column, numerous internal branches are given off, which unite with one another, with those of the opposite side, and often with filaments of the pneumogastric nerves, so as to form great plexuses with or without well-marked ganglia, with which the various glandular organs and hollow viscera of the body are in connection by means of afferent and efferent fibres. On the course of these visceral nerves many smaller ganglia, constituting subordinate centres, are to be found.

The sympathetic nerves are conducted to and come from the viscera, principally upon and along the course of the blood-vessels.

Some of the nerve-fibres on the visceral blood-vessels, and a much larger proportion of those on vessels going to other parts of the body, belong to a special set of the sympathetic fibres, which, from the nature of their functions, are known as *vaso-motor* nerves. Some of these fibres must have 'afferent' functions for the conveyance of impressions to vaso-motor centres; while others of them will transmit 'efferent' impulses; the two sets together serving to regulate the calibre of the blood-vessels, and consequently the amount of blood flowing through the different vascular territories. These vaso-motor nerves are connected with small ganglia distributed along the length of the blood-vessels, from which, in response to afferent impressions, motor stimuli may issue to such vessels and their branches. Such peripheral ganglia are, however, in subordinate relation with spinal vaso-motor centres, situated along the whole length of the cord, and these in their turn are dominated by a still higher regulating centre, situated in the medulla oblongata (near the lower extremity of the fourth ventricle), which appears to be in relation with all the vaso-motor nerves throughout the body. Modern observations would seem to show that there is another vaso-motor centre in the cerebral cortex; and this is believed by Benedikt, Meynert, and others to be situated in the hippocampus-major. The nature of its relations with the medullary centre are as yet uncertain.

Other fibres of the sympathetic system are mixed up on the vessels with those having a vaso-motor function. These others vary in function and in numerical proportion, according to the nature of the organ to which the vessels are proceeding. Thus to and from the liver, the pancreas, the salivary glands, and other allied organs, would proceed nerve-fibres, regulating the secretory and other vital actions taking place in the tissue-elements of the several organs; also from and to such organs there would proceed afferent and efferent fibres for rousing and regulating the activity of the contractile tissues in their respective gland-ducts. Again, there would lie on intestinal arteries, in addition to vaso-motor fibres, many other sympathetic fibres for the innervation of the muscular layers of the intestine, and many also for the different glandular elements of its mucous membrane. Lastly, in such an organ as the bladder, vaso-motor nerves, and nerves for the supply of its own proper muscular tissues, would exist in abundance, while those in relation with glandular elements would be comparatively scarce.

Whether over and above these different kinds of sympathetic fibres, others exist of the so-called 'trophic' type, seems at present to be extremely doubtful.

If, therefore, we consider the functions of the sympathetic system of nerves as a whole, we find that it has to do with the degree of contraction of the pupil; with the calibre of the blood-vessels generally; with the activity of all the glandular organs; with the movements of all the hollow viscera, and gland-ducts; and possibly in some special manner with the nutrition of all the tissues. And inasmuch as the nerves pertaining to this system, if not both the nerves and ganglia, are to be found in all parts of the body, it is to be expected that its functions may be more or less locally deranged, or its structure more or less damaged, by almost every form of disease, be it local or general. Every local inflammation must be associated with a perverted activity and deranged structure of sympathetic nerve-fibres in the inflammatory focus; whilst every fever will entail widespread and varied perversions in the functions of this system of nerves throughout the body. Owing, however, to the fact of the intimate structural relations existing between the sympathetic and the cerebro-spinal nervous system (*see* NERVOUS SYSTEM, Diseases of), it is more especially in diseases of the spinal cord and of the brain that we are accustomed to meet with definite sets of signs and symptoms referable to disordered or arrested action of portions of the sympathetic system. In the present article, therefore, the disorders of the sympathetic system will be very

briefly considered as they occur: (1) in association with diseases of the spinal cord and brain; and (2) independently of affections of the cerebro-spinal nervous system.

**1. Diseases of the sympathetic system in connection with the cerebro-spinal system.**

(*a*) *The spinal cord.*—Lesions of the *cervical* region of the spinal cord may be associated with extreme contraction or extreme dilatation of the pupil on one or both sides; with increased heat and redness, or the reverse, of the head and neck; with perverted respiration; with perverted action of the heart; and possibly with an exalted febrile heat of the whole body (*see* SPINAL CORD, Diseases of, § 9). Though we regard these phenomena as signs of disease in this particular portion of the spinal cord, it is none the less true that such phenomena are due to altered activities in those root-portions of the sympathetic system of nerves which take origin in, or traverse, this region of the cord. This is shown by the fact that similar sets of symptoms are produced by injuries, tumours, or other morbid processes implicating the cervical sympathetic itself.

It will be well to cite here the phenomena commonly associated with *irritation* or *paralysis* of the cervical sympathetic nerve, on account of their importance as diagnostic indications.

The signs dependent upon *irritation* of the cervical sympathetic in its *oculo-pupillary* fibres are—dilatation of the corresponding pupil with sluggish action, widening of the palpebral fissure, prominence of the eyeball, feeling of tension in the eye (as in glaucoma), and a scanty secretion of tears and mucus; whilst in its *vaso-motor* fibres they are—lowering of temperature of the side of the face and head, diminution of sensibility, an absence of perspiration, with (if the irritation continue) a tendency to slight atrophy of the side of the face. The signs of *paralysis* of the cervical sympathetic in its two sets of fibres are the direct opposites of those above cited, so that it is not necessary to enumerate them. Of these signs, those dependent upon irritation or paralysis of the oculo-pupillary fibres are usually much more constant and durable than those which depend upon irritation or paralysis of the vaso-motor fibres. These latter signs are, for reasons at present unknown, often transitory and fitful. Sometimes there may be signs of paralysis of oculo-pupillary fibres co-existing with signs of irritation of the vaso-motor fibres, or *vice versâ*. It has been definitely determined that injury in the lower cervical region of the cord, and as far down as the level of the *second dorsal* nerve, may give rise to the oculo-pupillary signs of one or other kind; and, on the other hand, that damage to the cord in these same parts, or as low down as the *fourth dorsal* nerve, may give rise to the above-mentioned vaso-motor signs.

When the *dorsal* and *lumbar* regions of the spinal cord are the seats of disease, other groups of phenomena will doubtless, after a time, be more fully recognised as results of irritation or paralysis of those roots of the sympathetic system which have their origin in or which traverse these particular regions of the spinal cord. It is therefore important to bear in mind the place of origin and the distribution of the different internal branches from the lateral sympathetic cords, which proceed from these regions to the different glandular organs or hollow viscera. Diarrhœa, sickness, obstinate constipation, sexual defects, and bladder-troubles, are among the symptoms which have such an origin, as well as undue heat or unnatural coldness of the lower extremities.

(*b*) *The brain.*—In different portions of the brain some of the signs and symptoms of disease are also referable to direct or indirect interference with the functions of the sympathetic system of nerves; but they constitute (apart from vaso-motor derangements, which are very common and often well-marked) far less distinctive aggregates, owing to the fact that the sympathetic system of nerves has a much less extensive relation with the brain than with the spinal cord. In this direction, however, and in connection especially with diseases of the medulla oblongata, we have to bear in mind the occasional occurrence of diabetes, polyuria, or albuminuria; also of some cardiac and respiratory derangements.

**2. Diseases of the sympathetic system proper.**—Where disease exists in the ganglia of the sympathetic system itself, or where it involves them, we get groups of symptoms more clearly referable to disordered activity of this system of nerves alone.

These will differ in particular cases, according to the nature of the morbid change, that is, according as it is destructive or merely irritative; and according to the number or particular combinations of ganglia and fibres affected. The ganglia and related plexuses may either be implicated by *intrinsic* morbid processes, or may be variously involved *from without* by morbid processes having their origin in other adjacent tissues.

*a. Intrinsic changes.*—The principal intrinsic morbid processes which have been hitherto recognised *post mortem* in some one or other of the sympathetic ganglia are:—pigmentary degeneration; cirrhotic overgrowth of their connective tissues, with or without secondary atrophy (the ganglia in such cases being either smaller or larger than natural); a highly congested and varicose state of their blood-vessels; effusion of blood into their substance; new growths starting from their substance; and fatty degeneration, with more or less marked atrophy. It is unnecessary to repeat here the statements relating to the pathology of such changes, which have been made under NERVOUS SYSTEM, Diseases of.

*b. Extrinsic disease.*—Different parts of the sympathetic system may become involved in new growths or in abscesses; or they may be simply pressed upon by aneurismal or other tumours occurring in contiguous regions of the body.

Besides the pathological conditions already enumerated, it should be borne in mind that in altered blood-states, whether cachectic or of febrile origin, we commonly have, and especially in the latter class of cases, a greatly perverted activity of the sympathetic system throughout the body—as evidenced by the altered vascular conditions, increased tissue-metamorphosis and

body-heat, together with the perverted activity of most of the glands in the body. *See* FEVER.

But to what extent the actual structure of glandular or blood-making organs may be perverted by primary or secondary morbid changes in related portions of the sympathetic system, we have yet to learn. Waxy degeneration of the liver or spleen may, for instance, be a result of certain perversions of the normal life-processes taking place in the elements of these organs, primarily induced by changes in the quality of the blood, such as occur in many cachexias. But whether this altered blood acts directly upon the tissue-element, and brings about the structural change known as waxy degeneration; or whether cachectic states of the system entail upon the sympathetic centres a perverted nutrition, and a consequent perverted influence upon the tissue-elements of related organs, whereby they, being at the same time fed only by impoverished blood, lapse into those lower modes of vitality which result in the degenerative change above-mentioned, are unsettled questions, well worthy of consideration. These remarks, with suitable modifications, are applicable as regards the possible instrumentality of related portions of the sympathetic system, in causing other varieties of morbid change in other organs of the body.

The principal disorders other than those due to structural diseases of the cord and of the brain, in which derangements of the sympathetic system of nerves exist, or are believed to exist, and in which such derangements have either wholly or in part a causal relationship to the principal signs and symptoms of the respective disorders, are as follows:—epilepsy; convulsions; migraine (hemicrania); exophthalmic goître; unilateral hyperidrosis; progressive facial hemiatrophy; angina pectoris; asthma; diabetes; Addison's disease; gastralgia; enteralgia (colic); neuralgia cœliaca; neuralgia spermatica; and uterine neuralgia. (See *'Phys. and Pathol. of Sympath. Syst. of Nerves'* by Eulenberg and Guttmann, 1879.) Among the affections more doubtfully or partially related to disorders of the sympathetic we may mention glaucoma; neuro-retinitis; progressive muscular atrophy; pseudo-hypertrophic paralysis; locomotor ataxy; diphtheritic paralysis; and so-called 'reflex paralysis.' In the special articles on most of the first group of affections, the reader will find references to the dependence of such conditions upon disorders in one or other department of the sympathetic system.[1]

H. CHARLTON BASTIAN.

**SYMPTOM**
**SYMPTOMATOLOGY** } *See* DISEASE, Symptoms and Signs of.

**SYNCOPE** (*συγκοπή*, a faint).—SYNON.: Fainting; Fr. *Syncope*; Ger. *Ohnmacht.*

DEFINITION.—A state of suspended animation, due to sudden failure of the action of the heart.

ÆTIOLOGY.—Syncope may be due to any condition which interferes with the action of the heart, whether acting (*a*) *intrinsically*; (*b*) through the *nervous system*; (*c*) through the *blood*; (*d*) through *more than one* of these channels.

[1] See also Long Fox on 'The Influence of the Sympathetic on Disease,' *Med. Times*, Sept. 2, 1882.



(*a*) Syncope due to *intrinsic* cardiac conditions is chiefly seen in organic diseases of the heart, especially fatty degeneration. Amongst other examples of this class of causes, may be mentioned compression of the heart by diseased conditions, or by tight articles of dress; excessive heat, whether natural or artificial, as in sunstroke and the warm-bath; lightning; and certain drugs and poisons, including chloroform.

(*b*) The most common *nervous* causes of fainting are of an emotional kind, such as fear, grief, or joy, in nervous or hysterical women. Sudden injury of the central nervous system, as in concussion of the brain, has partly the same effect. In a larger number of instances the nervous causes of syncope act reflexly, and are to be found in conditions of the stomach or intestines (corrosive and irritant poisoning, indigestion, worms, scybala); in the liver, kidneys, or uterus (injuries, calculi, displacements); or in the limbs or body generally (painful injuries of any kind). Spasm of the arteries, due to reflex irritation of the vaso-motor nerves (cold and certain poisons), may also lead to syncope.

(*c*) Of the causes of syncope connected with the *blood* the most frequent is hæmorrhage. Chronic anæmia, as seen in idiopathic and pernicious cases, or accompanying chronic constitutional diseases, is a common cause of serious fainting.

(*d*) In a large number of instances, however, the causes of syncope are *complex*. Thus in fainting from hunger and exhaustion the heart is depressed directly, as well as through the nervous system, and through the blood; and in severe injuries, such as railway accidents, there may be a combination of depressing causes, including fear and grief, hæmorrhage, painful lesions, cerebral concussion, and shock. Fainting in a hot, impure atmosphere appears to be due partly to the direct effect of heat upon the circulation; and partly to the interference with respiration, and indirectly with the heart, produced by carbonic acid.

In a person subjected to any of the predisposing causes of syncope already mentioned, the occurrence of fainting may be determined by a very slight exciting cause. It is thus that in serious cardiac disease, in hysterical subjects, and in persons suffering from anæmia, the smallest excitement or exertion, unpleasant sights or smells, or exposure to an impure and heated atmosphere, may cause faintness, and in some instances even fatal syncope.

ANATOMICAL CHARACTERS.—In death by syncope the organs generally are found to be anæmic; and if hæmorrhage have occurred, this condition is particularly marked. The state of the heart varies with the cause of its failure, the ventricles being either dilated and full of blood, or empty, as in cases of fatal hæmorrhage, and possibly contracted.

SYMPTOMS.—A syncopal attack presents three stages, namely: (1) *a period preceding loss of consciousness*; (2) *a condition characterised by insensibility*; and (3) *a period of recovery* from the fainting state.

(1) A person about to faint is observed to turn suddenly pale; he staggers, or leans against the nearest support; the eyes roll upwards,

whilst the eyelids tremble or close; and consciousness and general sensibility are impaired. The pulse fails, generally becoming weak, small, and frequent; in other instances it is infrequent, irregular, or intermittent. The respiration is irregular and feeble. Vomiting may possibly occur.

At the same time the patient has a number of subjective sensations. The most urgent of these are a sense of 'sinking' in the epigastrium, a feeling of increasing debility, 'giddiness' in the head, and a tendency to fall. Vision becomes indistinct; the hearing is usually impaired, rarely more acute, or tinnitus is present. Mentally there is a rapid fading of sensory impressions and of consciousness; whilst in cases of fainting from loss of blood there may be restlessness, agitation, and delirium.

(2) The phenomena of the first stage are now complete. The muscles are relaxed; the patient falls; and consciousness is completely lost. The surface is pallid, and possibly cold and clammy; the eyes are closed, and the pupils dilated; the pulse and the cardiac impulse and sounds are nearly or quite imperceptible; respiration is indistinguishable, or occurs as occasional weak sighs; and the vital functions generally appear to have ceased. In cases of syncope due to severe hæmorrhage general convulsions may occur.

(3) Recovery from syncope is marked by signs of gradually returning consciousness, increase of the pulse at the wrist, and restoration of the functions generally. The first obvious signs of improvement are usually slight movements of the hands and features, and deep sighing. Thereupon the pulse becomes more distinct; the cardiac impulse and sounds are found to be stronger; the senses of sight and hearing can be excited; colour returns to the face and lips, and warmth to the extremities; and intelligence is gradually restored. Very shortly the patient may be able to resume the sitting posture; and the seizure is at an end.

Duration and Terminations.—The duration of the several stages of syncope varies greatly, from a few seconds even to hours. In many instances the attack does not pass beyond the first stage; in rarer cases insensibility may last for an almost indefinite time. The most common termination is in recovery; but syncope is one of the ordinary modes of death, especially in hæmorrhage and organic disease of the heart. In nervous subjects partial recovery may be quickly followed by the return of the fainting state, the patient being said to 'pass out of one faint into another.' Where referable to organic disease or to hysteria, syncope may recur at intervals for many years.

Pathology.—Syncope consists essentially in sudden failure of the action of the heart, originating in any of the causes already mentioned, and leading to the condition of acute general anæmia. Whether from some affection of the heart itself, from sudden interference with the nervous impulses which regulate its action, from failure in the regularity of the supply of blood within its cavities and in its substance, or from a combination of such causes, the systolic contraction suddenly becomes short and feeble. If there have been no hæmorrhage, the result is distension of the cardiac cavities with blood, and further embarrassment; but if profuse hæmorrhage have occurred, the heart may be deprived of blood, and thus of the natural stimulus to contraction. In either case fatal cardiac paralysis may be the result, unless the contractile power be speedily restored.

The acute general anæmia which is the result specially affects the central nervous system. In the erect posture the circulation fails first within the cerebrum, producing rapid disturbance and then loss of consciousness, and depressing the centres that regulate the heart, vessels, respiration, and stomach. The general muscular paralysis which occurs at the same time is also partly of central origin. Similarly, the convulsions which may ensue in cases of hæmorrhage are probably referable to sudden circulatory disturbance within the basal ganglia and cord. The senses are further obscured by anæmia of their special organs; the heart is more depressed by failure of the coronary circulation; the paralysis of the muscles is increased by want of blood within them; and the temperature falls from failure of the circulation generally.

In non-fatal cases recovery naturally occurs by restoration of the cerebral circulation in the recumbent position, and consequent stimulation of the cardiac centre. Other circumstances favour the recovery of the general circulation, such as the relaxation of the arteries, and the partial restoration of the respiratory and other functions, which quickly react upon the heart.

Diagnosis.—Syncope has to be diagnosed from other conditions in which loss of consciousness is a prominent symptom; and chiefly from epilepsy 'apoplexy' from any cause, concussion of the brain, shock, and from poisoning of many kinds, including suffocation by certain gases and drunkenness. From such of these conditions as commence in the brain, and from poisoning (unless the poisons act as cardiac depressants) syncope is readily distinguished by the characters of the pulse. The diagnosis of shock, which usually produces a degree of syncope, is described in the article on that subject. *See* Shock.

Prognosis.—The prognosis of syncope depends upon its cause, and upon the practicability of immediate treatment. If due to organic disease of the organs of circulation, or to serious injury, acute poisoning, excessive heat, or profuse hæmorrhage, the case is serious, and may prove fatal unless treatment be instantly applied. If, on the other hand, the cause of the faintness lie in an excitable nervous system, momentarily depressed by some passing emotional disturbance, or by impurity of the atmosphere, the attack may be pronounced free from danger, although liable to recur.

Treatment.—In the treatment of syncope two indications are equally urgent, namely, removal of the cause of faintness, and restoration of the action of the heart. If the patient should not have fallen, he must be immediately laid flat on his back; the atmosphere should be rendered as pure as possible by throwing open the windows and doors, by removal to the open air, and by preventing people from crowding around; and the dress should be loosened about the neck, chest

and abdomen. If hæmorrhage occur, means must be taken to stop it. Cardiac stimulants, direct or indirect, must then be employed. The most available and powerful of these is alcohol, in the form of brandy or other spirit; and this may be given either pure or in water, and in an amount which will vary with the individual case, as estimated by the immediate result. Sal volatile, ether, eau de Cologne, if available, are equally valuable cardiac stimulants. Should the patient be unable to swallow, these substances, as well as warm liquids, must be given at once as enemata; or ether may be injected under the skin of the præcordium. Carbonate of ammonia ('smelling salts') and other strong smelling compounds, including perfumes, fanning, cold douches, and refrigerant applications of eau de Cologne or other spirit to the temples and hands, are other ready methods of exciting the heart reflexly through the nervous centres. If these measures fail after a fair trial the condition of the patient is very serious. The systematic employment of efficient means of resuscitation must then be had recourse to, including friction of the limbs and trunk, galvanisation of the region of the heart, and even transfusion of blood. *See* Resuscitation (A.).

In cases ending favourably the patient must be careful not to assume the erect position too hastily, or to undergo much exertion, until some rest have been obtained or some stimulant or nourishment administered.

The occurrence of syncope is sometimes the first indication of the existence of serious organic disease of the heart or other organ; and it should suggest a careful examination of the patient, and the adoption of measures likely to prevent the return of such a dangerous symptom, that is, the avoidance, as far as they are avoidable, of the principal causes already mentioned.

J. Mitchell Bruce.

**SYNOCHA** (συνοχέω, I carry with).—Synon.: *Febris continua.*

**SYNOCHUS** (συνέχω, I hold or keep together).—Synon.: *Febris continens.*

Synocha and synochus are now obsolete terms, which were used for many centuries as epithets of two distinct types of fever, but in different senses at different periods. A complete history of their varying meanings would occupy much space; a few illustrations of it only need be given. *Synocha* does not occur in Galen's extant writings; and *Synochus* is by him contrasted with πυρετὸς συνεχὴς, and defined to be a fever whose course is steady and uniform from its beginning to its end. Under it, in his *Method. Medend.*, lib. ix., cap. iii. he admits three varieties, namely, 1, when the temperature remains steady; 2, when it rises steadily; and 3, when it falls steadily, during the whole course of the fully established disease. The meaning of the term has no reference to the duration of the fever. πυρετὸς συνεχὴς, on the contrary, is a fever with paroxysms and remissions. Galen, *Definit. Med.*, 186-7.

In the second edition of Stephen Blancard's *Lexicon*, A.D. 1717, from which the etymology given above is taken, synocha is a continued fever, of several days' duration, with paroxysms and remissions, attended by remarkable heat, and sometimes putrid. It may be either quotidian, tertian, or quartan. By this he seems to mean that exacerbations may take place on those days, but the fever is remittent not intermittent. Synochus is a continuous fever (*febris continens*), often lasting several days, unattended by serious symptoms, and is either simple or putrid, according to its severity.

Linnæus, in 1763, and De Sauvages, in 1768, both define synocha to be a fever not lasting more than a week, synochus one not lasting more than two or three weeks.

Cullen, in 1785, dissatisfied, he says, with the previous use of the words, gives to them a special meaning of his own. In his nosology synocha is a fever with very high temperature; a frequent, strong, hard pulse; red urine; and very little disturbance of the sensorium. Synochus is a contagious disease, in which the fever combines the symptoms of synocha and of typhus; beginning as synocha, towards the end it becomes typhus.

With this variety of meaning it is not surprising that the same disease is placed under synocha by one author, under synochus by another. As the further use of these terms, apart from their incongruity with modern systems of classification, can only perpetuate this confusion, they may be allowed to become obsolete.

James Andrew.

**SYNOVIAL DISEASES.** *See* Joints, Diseases of.



**SYPHILIS** (etymology uncertain. Perhaps from σὺν, with, or σῦς, a swine, and φιλέω, I love; or from σιφλὸς, crippled, maimed).—Synon.: Vulg., Pox; Fr. *Vérole*; Ger. *Lustseuche.*

Definition.—A specific contagious non-infectious disease; communicable by contact of the poison with a breach of surface, or by hereditary transmission. Syphilis is characterised by a period of incubation; and (except in the case of inheritance) by certain changes at the seat of contagion, and in the proximate lymphatic glands. These are followed by an eruption on the skin and mucous membrane, and sometimes by lesions of the deeper tissues and viscera.

History.—The origin of syphilis is unknown. In India and China there is little doubt that the disease existed centuries ago; but the time at which it first appeared in Europe has given rise to much discussion, and is still the subject of dispute. Some writers maintain that syphilis was introduced by the followers of Columbus from the West Indies, on their return from the discovery of Hayti in 1493. Others again hold that it first broke out among the French soldiers during the siege of Naples in 1494–5. There can be no doubt that syphilis of a very severe character was prevalent in Southern Europe towards the close of the fifteenth century, when indeed it seems to have been first clearly recognised and described; but it is also probable that the disease had existed even in Europe long before that time.

Ætiology.—There is but one cause of syphilis, namely, the absorption of the virus into the blood, and its gradual diffusion throughout the

body. It was formerly taught—a doctrine for which John Hunter was largely responsible—that syphilis, the soft chancre, and gonorrhœa were due to one virus. This was more or less generally accepted until 1838, when Ricord's researches confirmed the conclusions arrived at long before by Balfour (1767), and Benjamin Bell (1793), to the effect that gonorrhœa had nothing whatever to do with the other two disorders. The next step was completed in 1852, by the publication of Bassereau's evidence, based on the comparison of a large number of cases of venereal sore with their source of contagion. The results of these observations tended to show that the 'soft chancre' was a local affection, quite distinct from the general disease syphilis. This is the view most generally held at the present day, and those who hold it are now called *dualists*. A smaller number of authors, however, still maintain that syphilis and the soft sore are products of the same virus, and to such the term *unicist* is applied. The discussion of *unity* and *duality* does not come within the scope of this article. It is sufficient, therefore, to state that it is from the more generally accepted or *dualist* point of view that the present account is written. Consequently, when the term syphilis is used, the constitutional disease is always to be understood. The local suppurating sore or soft chancre is described elsewhere. *See* Venereal Sore.

One attack of syphilis usually affords protection against a second throughout the lifetime of the individual. In the rare instances in which a person suffers more than once, the second attack is, as a rule, modified by the previous one.

Besides being capable of contaminating others by direct contact, the subject of acquired syphilis is also liable, during a variable period, to transmit the taint to his offspring; but whether the inherited form of disease be further transmissible to the next generation remains doubtful.

It is probable that many persons, though exposed to contagion, escape syphilis as they escape other contagious diseases, from want of susceptibility. On the other hand, some persons appear to be particularly susceptible to noxious influences, and suffer more than once from the same contagious disorder. The reason of such peculiarity is not yet understood.

Pathology and Anatomical Characters.—The essential nature of the syphilitic poison is unknown. Certain elements have been reported as found exclusively in the blood or tissues of syphilitic persons; but not on conclusive evidence. The recent views on this subject of Klebs, Aufrecht, and Birch-Hirschfeld will be found in the *Lancet* for August 26, 1882, p. 316. Whether syphilis is a special disease or to be classed among the exanthemata, need not be discussed here. It will be sufficient to point out that while it resembles the acute fevers in having a period of incubation, in the development of an exanthem, and in the protection commonly afforded by one attack against subsequent ones, it yet differs from them in its long duration and liability to relapse, in the non-infectious nature of its poison, and in its capability of being greatly influenced by certain remedies.

When the syphilitic poison has been absorbed, it multiplies until the whole system becomes pervaded by it. How soon this absorption takes place is not known. Some believe that the virus remains localised at or about the seat of inoculation during the incubation-period. Hence, of late years excision of the initial lesion has been again extensively practised by Auspitz and others, with the object of preventing further development of the disease. The results of these experiments, however, have not, so far, proved that the removal or destruction of the initial manifestation at any stage of its development can prevent general infection.

The changes which syphilis produces in the tissues are chiefly of an inflammatory nature. The process, which is essentially the same in the primary induration and in the later manifestations of the disease, begins by the production of numerous small round cells, which are situated chiefly in the outer portion of the sheath of minute blood-vessels, and imbedded in a delicate stroma. Thus the growth is of the nature of granulation-tissue, and does not present any elements peculiar to syphilis. It is at first a highly organised tissue, rich in blood-vessels; but subsequently shows a marked tendency to vascular thrombosis and consequent degeneration.

The new growth may develop in a diffused infiltrating form, involving a greater or less extent of the invaded tissues; or in the circumscribed masses known as gummata. Any of the structures of the body may be attacked, most commonly, perhaps, the subcutaneous connective tissue; but bone, muscle, the blood-vessels, the placenta, and the internal viscera are all liable to suffer; and although the morbid growth is essentially the same wherever it is developed, it of course presents differences in appearance, according to the particular tissue or organ affected.

It is, however, the circumscribed swelling or *gumma* that is most characteristic of syphilis. In its typical form it appears as a yellowish, tough, somewhat elastic, and sharply circumscribed mass, varying usually from the size of a marble to that of a large chestnut. It is also often caseous in the middle, and is surrounded by a highly vascular fibrous investment. Gummata are frequently associated with the diffused form of growth, which after a time becomes converted into a tough fibrous tissue; this finally contracts, and thus puckers, deforms, and often seriously affects the functions of the organ in which it grows. Fibroid induration and scarring are not uncommonly discovered in the organs of syphilitic subjects, but fibroid disease is not generally recognised as being unquestionably syphilitic unless gummata be also present.

Besides the changes that have just been described, *lardaceous disease* is frequently caused by syphilis. Indeed this is probably the commonest visceral affection found in the bodies of old syphilitic persons.

Modes of Communication.—Before considering the different ways in which syphilis may be propagated, it is necessary to mention the vehicles of the virus. These are:

1. The discharge of the initial lesion.
2. The secretions of all the secondary eruptive

lesions, especially of the moist papules known as mucous patches or tubercles.

3. The blood, during the continuance of secondary symptoms.

The secretions of the later or tertiary affections have not been proved to be contagious, nor have the physiological secretions of a syphilitic person—for example, the saliva, sweat, tears, semen, milk—unless mixed with the secretions of syphilis or with the blood, even though the disease be in an early stage. Further, the secretions of other diseases from which a syphilitic person may be suffering are not always contagious. This at least is the case with regard to vaccinia; for healthy children have been often vaccinated from syphilitic ones without contracting syphilis.

The sources of contagion being so numerous, it is easy to understand that the modes of communication must be so also. They may be described under three heads:—1. *direct contact*; 2. *mediate communication*; and 3. *hereditary transmission.*

1. *Direct contact.*—In the great majority of cases syphilis is imparted during sexual intercourse, first, because the genital organs are the most frequent seat of the contagious lesions; secondly, because the delicate epithelium of those organs is especially liable to abrasion during coitus. Hence syphilis is usually described as a venereal disease, but it should always be remembered that it is not necessarily so. Wherever the poison comes in contact with a broken surface, it may be absorbed and general infection follow. Instances of syphilis being conveyed quite independently of sexual relations are unfortunately far from rare. Perhaps the most frequent mode of extra-genital contagion is the contamination of a wet nurse by a syphilitic child, or of a child by its nurse. The disease may also be spread by kissing, contagious syphilitic lesions being very common about the lips and in the mouth. Again, medical men and midwives not unfrequently contract syphilis by attending diseased women in labour; and surgeons by examining or operating upon syphilitic persons.

2. *Mediate communication.*—When syphilis is communicated indirectly the medium may be of almost endless variety. Articles which are used in common by different persons, such as spoons, drinking vessels, pipes, &c., are perhaps the commonest media; implements used in various trades—the tubes used in glass-blowing, for example—have also acted in the same way. Again, through the performance of tattooing, cupping, catheterisation of the Eustachian tube, &c., by ignorant persons and quacks, the disease has been communicated, and it has also happened during vaccination; but in this country, where that operation is performed only by duly qualified medical men, such an accident is of extreme rarity. Another mode of mediate communication, where one person conveys syphilis to a third through the medium of a second who escapes contagion, has also been described by various authors.

3. *Hereditary transmission.*—Our knowledge is still imperfect respecting the ways in which syphilis may be transmitted from parent to child; and the questions involved are much too wide for discussion in this article. Consequently, no attempt will be made to do more than state briefly the facts which are most generally accepted, and the most usual course of events when syphilitic persons become parents.

In the first place it must be remembered that the child does not *necessarily* become contaminated, in whatever stage of syphilis the parents may be. As a rule, however, the more recent the infection of the parents the more likely is the child to inherit the disease. The elder children usually suffer most severely; but this is by no means always the case. For instance, treatment has great influence over the transmissive power, and a healthy child may be born while the mother is under the influence of mercury, but a subsequent one may be tainted, if treatment have been discontinued, and the disease have again resumed activity. There are also periods of quiescence in syphilis independent of treatment, during which healthy children are sometimes born. When the infection of both parents is recent the child almost invariably suffers, and this is also the case if the mother alone be diseased. Under such circumstances abortion or premature birth is common. When the father alone is syphilitic, both mother and child may escape. Some believe that a syphilitic father may procreate a diseased child while the mother escapes, but this is by no means proved. Indeed, it appears most probable that the mother of a syphilitic child does not really escape contagion, although she may show no characteristic signs of the disease. The most weighty evidence in support of this view is that known as 'Colles's law'—namely, that the mother of a syphilitic child never becomes infected by it after birth; and further, seems proof against contagion in any other way. In the cases where the mother does not show the ordinary early signs of syphilis, it is believed by many that the fœtus becomes diseased directly by the father, and in turn infects the mother through the placental circulation (*'choc en retour'*). There is much evidence in favour of this view. Lastly, if the mother acquire syphilis during the earlier months of pregnancy the child commonly suffers; but if she be infected after the seventh month the child may escape.

Symptoms.—The symptoms of syphilis are usually divided into three groups—**primary, secondary,** and **tertiary.** And although such division is really artificial, it will be useful to retain these terms for the purpose of description; but it must be borne in mind that the patient during the primary stage is just as much the subject of syphilis as during the stage of general symptoms, and that in certain cases the signs proper to all three periods may be present at the same time.

**Primary syphilis.**—A patient is said to be suffering from primary syphilis as long as the initial manifestation (hard chancre), and the accompanying glandular enlargement, remain the sole signs of the disease.

When the syphilitic poison, unmixed with any irritating matter, has been inoculated, the abrasion quickly heals, and no further change is observed for three weeks or a month. This interval is called the period of *incubation*, and its average

length, judging from cases of experimental inoculation, is about twenty-four days; but it may be as short as ten, or as long as forty-six days. After the lapse then usually of an interval of three or four weeks, a certain change occurs at the site of inoculation, which is called the *initial* manifestation or lesion. This may assume various forms, and is commonly termed a *hard*, or *indurated*, or *infecting chancre*. The initial lesion presents certain differences in appearance, according to its position, and according to whether it be irritated or not. Its chief characteristic is the presence of induration at its base, and the aspect of the sore is much affected also by the degree in which this hardness is developed. Sometimes the lesion appears as a hard desquamating papule; sometimes as a well-marked indurated ulcer, having a hard well-defined base and thickened adherent margins (the so-called '*Hunterian chancre*'); but most commonly as an erosion or shallow ulcer, with an amount of induration which varies much in different cases, and which is not always easily appreciable unless care be taken. Sometimes the induration develops in a thin layer, like a piece of parchment or even paper; hence the term 'parchment sore' often applied to this form of the initial lesion. In rare instances, especially in women, induration appears to be absent altogether. The secretion is thin, scanty, non-purulent, and not inoculable on the bearer. Hence, the syphilitic primary sore is usually *single*, contrasting strongly in this respect with the local chancre, in which multiplicity is the rule. The sore is indolent and often painless, and tends to disappear spontaneously after having lasted several weeks or months.

The *seat* of the initial lesion is most frequently the genital organs, but, as has already been stated, absorption of the poison may occur in any situation where a breach of surface exists. Consequently the initial lesion may be found on any part of the body, as about the lips or mouth in children, on the nipple in nurses, or on the hand or finger in the case of doctors and midwives.

If, as frequently happens, irritating matter of any kind have been inoculated along with the syphilitic poison, the course of events will vary according to circumstances. Thus, if it be mixed with ordinary pus, irritation will begin at once at the site of inoculation. Again, if the pus of the local chancre have also been absorbed (a very common occurrence), the period of incubation will be occupied by the course of the suppurating sore, which may or may not have healed at the time the change peculiar to syphilis occurs. If the sore be still present, induration will develop, and the lesion will for a time assume the characters of both varieties of sore; but if it have healed, the cicatrix will harden and eventually assume more or less closely the appearance of one or other of the varieties of initial lesion which have just been mentioned.

The progress of the initial lesion is usually slow. The duration varies from two or three weeks to several months, according to its size, and the influence of treatment. It sometimes breaks out again after cicatrisation; induration may also reappear without fresh contagion. If the sore, from irritation of any kind, be made to suppurate, the secretion may become inoculable on the bearer. When the chancrous and syphilitic poisons have both been inoculated, the resulting lesion has been termed by Rollet a 'mixed chancre.'

*Glandular Enlargement.*—On whatever part of the body the initial lesion may be situated, the nearest lymphatic gland or glands become perceptibly enlarged in from seven to fourteen days after its appearance. The whole group is usually affected, but the gland most directly connected with the point of contagion enlarges first, and often attains a greater size than the others. Each gland can be felt as a separate distinct indolent swelling, usually about the size of a marble, the cellular tissue and skin remaining free. At this time the enlargement commonly remains limited to the nearest group, but later is sometimes general. Suppuration of the glands probably never occurs unless there be some source of irritation in addition to the syphilitic poison; or the patient be scrofulous, or over-exert or injure himself, or be in bad health from some other cause. Even when suppuration does occur, the abscess is always of a simple nature, and the matter is not inoculable on the bearer unless the local chancre be present as well, and direct absorption of chancrous pus take place (*see* Bubo). Besides the glands, the *lymphatic vessels* leading to them—those of the penis, for example—are frequently enlarged also, and can be felt as hard cords, freely movable beneath the skin.

**Secondary Syphilis.**—After the development of the initial manifestation, with its accompanying adenopathy, another interval occurs before further signs appear. This period is sometimes called the 'second incubation,' to distinguish it from that which intervenes between contagion and the appearance of the initial lesion. This second period of quiescence, counting from the appearance of the initial lesion to the appearance of the general eruption, is usually, unless prolonged by treatment, about six weeks. Thus as a general rule it may be stated that the exanthem appears from sixty to seventy days after contagion; from forty to fifty after the initial lesion; and from thirty to forty after enlargement of the proximate lymphatic glands.

During the earlier part of this period the patient commonly does not feel ill, but towards its close, and shortly before the appearance of the exanthem, some patients, especially women, if they be not already under the influence of mercury, develop certain symptoms of constitutional derangement which have received the name of *prodromata*. Thus the patient may become pale and anæmic, and may suffer from shortness of breath and lassitude. In addition, headache, loss of appetite, malaise, pains in the limbs and back, and sometimes rise of temperature, and other symptoms known under the name of 'syphilitic fever' are present. During this period also, as was first pointed out by Ricord and Grassi, whose conclusions have since been confirmed by Wilbouchewitch, Keyes, and others, the proportion of red blood-cells is diminished. The prodromata are usually mild in degree, but occasionally they are intense. Thus, headache may be agonizing, and in rare instances the amount of constitutional disturbance is so great that the onset of one of the acute specific fevers may be suspected.

*Cutaneous system.*—At the end of this second interval of quiescence then, and having been preceded or not by some of the symptoms just mentioned, the first general eruption appears. This, in the vast majority of cases, takes the form of roseola, consisting of numerous rosy red spots, varying in size from a hemp-seed to a shilling, fading on pressure at first, but afterwards becoming dull red or brownish, and finally disappearing altogether, sometimes with slight desquamation of the cuticle. The spots usually appear first about the flanks, chest, and abdomen. The extent and duration of roseola vary much in different persons. It may be limited to a few faint spots on the anterior surface of the trunk, or the whole body may be covered with the rash, in which case it often greatly resembles that of measles. Roseola may appear suddenly and disappear quickly, or it may last for several weeks and indeed occasionally for months, if untreated. It sometimes relapses, but in that case is never general, being usually limited to a few blotches on the forehead, trunk, or limbs.

As the macular eruption fades, papules not uncommonly appear, so that a maculo-papular eruption is often seen in early syphilis. The papules are raised, bright red at first, but soon changing to the so-called 'coppery' hue, which, however, is much more like that of raw ham. Finally, the cuticle separates in scales, leaving a characteristic silvery border or 'collarette' round the base of the papule. The papules are very liable to relapse, and the oftener they re-appear the more scaly they become. When they fade a brown stain is left, which gradually disappears without leaving any scar. At this time also crusts are frequently present on the scalp among the hair, which itself becomes dry and withered, and at a later period very often falls out either generally or in patches. Besides the scalp the eyebrows, eyelids, axillæ, and indeed all the hairy regions of the body, may suffer. The nails also are liable to be attacked in several ways. *See* Nails, Diseases of.

Though the macular and papular syphilides are by far the most frequent forms of early rash, vesicular, pustular, and ulcerating eruptions sometimes appear during the secondary stage, the two latter being most common in patients of bad constitution.

The earlier eruptions are usually superficial, and widely spread. The colour is at first bright red, but afterwards ham-red. Except in the case of the earliest rash, the papule forms the base of the eruption. Irritation and itching are usually absent. The eruption has certain favourite seats, namely, the trunk, the border of the hairy scalp, and the flexor surface of the limbs, including the palms and soles. Several forms of eruption are often present at the same time; most commonly maculæ and papules, but sometimes papules and vesicles, or pustules. They all tend to disappear spontaneously, and, except the pustular form, without leaving any scar.

*Mucous membranes.*—Besides the affections of the skin, lesions of the mucous membrane, particularly that of the mouth and throat, are nearly always present during the secondary stage. Erythema, excoriations, or shallow ulcers are very common about the fauces and tonsils, as well as on the buccal surface and tongue, during the early portion of this stage; and the nasal and laryngeal mucous membrane is also liable to be similarly affected. Equally common, though usually somewhat later, are mucous patches or tubercles (condylomata). They are merely the papules of the general eruption altered by moisture, and are most common on the mucous surfaces and in localities where skin and mucous membrane join, for instance, on the genital organs, at the angles of the mouth, and round the anus; but in dirty people they may form between the toes, about the umbilicus, and even behind the ears.

These affections of the skin and mucous surfaces are often accompanied by more or less deterioration of the general health, with pallor, lassitude, and considerable loss of weight. Pains in the muscles, bones, or joints (osteocopic pains) and sometimes periosteal swellings or synovial effusions also occur; as well as more or less general enlargement of remote lymphatic glands, particularly those of the neck and beneath the jaw; but the axillary, epitrochlear, and indeed all the glands within reach, may be enlarged. *Iritis* is also liable to come on about this time, and later, *choroiditis*. Sometimes, but more rarely, affections of the *auditory apparatus* are present.

The number, extent, and severity of the secondary manifestations vary greatly in different persons. In some cases roseola, and slight redness and excoriation of the throat, are the only signs that appear. In other instances roseola is succeeded by papular and scaly syphilides, and by obstinately recurring lesions of the mouth, throat, genital organs, or other parts of the body.

After the lapse of a period which varies usually from six to eighteen months, the secondary stage comes to an end, and in many cases the disease troubles the patient no longer. But supposing this not to be the case, there may be an interval of months or years during which no symptoms appear. Sometimes, however, symptoms continue to develop from time to time, which partake of the characters of both the secondary and tertiary stages, and which gradually merge into the latter without any strict line of demarcation between the two. Examples of these intermediate signs are thickened scaly patches on the skin, which often take a circular form, and sometimes ulcerate; obstinate eruptions of the soles and palms (the so-called plantar and palmar 'psoriasis'); ulcers of the tongue, gradually becoming deeper, and with thickened edges; periosteal swellings; orchitis; and affections of the choroid and retina.

**Tertiary Syphilis.**—While the secondary stage of syphilis is mainly characterised by the occurrence of superficial lesions, more or less widely spread over the surface, and tending to spontaneous disappearance; the main features of tertiary affections, on the other hand, are that they usually attack only a limited area, that they have a marked tendency to extend deeply and to cause destruction of tissue, with consequent contraction and scarring, and that they do not tend to spontaneous recovery.

The chief lesions usually classed as tertiary

are severe forms of eruption, such as rupia, and deep ulcers of the skin and mucous membrane; and diffused infiltration or gummata of the subcutaneous and submucous cellular tissue, muscle, bone and periosteum, testes, brain and spinal cord, blood-vessels and the internal viscera, of which the liver is most frequently attacked. The tertiary period, also, is often attended by severe cachexia, with a peculiar earthy pallor of the skin.

The syphilitic new growth may develop in a diffused or in a circumscribed form; but in either case, unless checked by treatment, degeneration is usually rapid, leading to obstinate ulceration when the superficial structures are attacked, and to the production of tough contractile fibrous tissue when the viscera are the seat of the new formation.

When the gummy growth develops in the skin or mucous membrane in a diffused form, it produces hard, flat plaques of varying extent. The skin after a time becomes purplish-red and adherent, and finally breaks down at several points; and an ulcer is left, which sometimes creeps over the surface (serpiginous ulceration), healing in the middle and extending at the margins, until a considerable amount of tissue is destroyed. When this diffused infiltration occurs in the pharynx, larynx, or rectum, the disease is very obstinate, unless actively treated at an early stage, and the ulceration and subsequent contraction may produce incurable and fatal stricture in any of those situations.

When the circumscribed form develops in the skin itself, it is known as a *syphilitic tubercle*, and when in the cellular tissue as a *gumma*. Gummata vary much in size. At first, they are small hard nodules, freely movable beneath the skin; but after a time they enlarge, soften, and become adherent to the discoloured integument, which finally gives way, exposing a mass of yellowish-white material, which is gradually cast off in the form of *débris*, and thin ill-formed pus. The cavity then heals by granulation, leaving a depressed scar.

The syphilitic affections of the other tissues, and of the various organs of the body, with their symptoms, will be found described along with the other diseases of the several parts. *See* Brain, Syphilitic Disease of; Bone, Diseases of; Liver, Syphilitic Disease of; Testes, Diseases of, &c.

**Malignant Syphilis.**—It has already been mentioned that the division of syphilis into a secondary and a tertiary stage is to a great extent artificial, and that it is often impossible to say under which title certain lesions ought to be classed. There are again cases, fortunately not common, to which the term malignant or galloping syphilis has been applied, in which the disease from the first pursues a rapid, destructive, and sometimes uncontrollable course. Skin-eruptions, which partake of the secondary stage in their wide-spread character, and of the tertiary in their tendency to ulcerate, appear early, even while the initial lesion is still present. Deep ulcers form also in the mucous membrane, and the gummy growth may develop in the internal organs, and cause death, or the patient may die worn out by exhaustion.

**Inherited Syphilis.**—Syphilis is a very frequent cause of *abortion*, which occurs most commonly about the fifth or sixth month. If the child be carried the full term, it may be born dead with or without signs of syphilis; most commonly, however, if the child be born alive it does not show any signs of the disease at birth.

In inherited syphilis the initial manifestation is of course absent, and the disease begins at the secondary stage. With this exception the symptoms of the inherited are in their main features similar to those of the acquired disease, allowance being made for the difference between the actively growing tissues of the child and the fully developed organs of the adult.

Supposing, then, the child to have been born alive, it usually shows no evidence of disease for a period ranging between two and six weeks after birth. It then, as a rule, gradually loses its healthy appearance, begins to snuffle, becomes fretful, and loses flesh rapidly. The skin assumes a dull dirty colour, and though loose, dry, and wrinkled, is very brittle and easily breaks round the mouth and nose into chaps and fissures, the scars of which often form a very characteristic sign in after-life if the child survive. Macular, papular, vesicular, or pustular rashes, resembling those seen in the adult, also appear, and mucous patches are nearly always present about the orifices of the body. Pemphigus is seen only in severe cases; it appears very early, and is frequently fatal. The lesions of inherited syphilis are just as contagious as those of the acquired form of the disease.

A peculiar feature of inherited syphilis consists in the tendency to visceral disease as well as to bone-lesions at an early period, even during intra-uterine life. These changes have been particularly described by Wegner, Parrot, R. W. Taylor, Barlow, Lees, and others of late years. The bones most liable to be attacked are those of the cranial vault, and the long bones of the extremities, particularly the humerus and tibia. *See* Bone, Diseases of.

In later life, inherited syphilis may manifest itself by a number of symptoms which were formerly ascribed to scrofula. The forehead is prominent, and the bridge of the nose sunken. The growth is checked, the individual being stunted, weakly, ill-nourished, and of low vitality. The skin is greasy and earthy-looking, and perhaps scarred by previous ulceration. The permanent teeth, especially the central upper incisors, as was first pointed out by Mr. Hutchinson, are conical or 'pegged' and sometimes notched at the free border (*see* Teeth, Diseases of). The cornea is liable to a low form of inflammation (interstitial keratitis), leading to opacity and more or less impairment of vision; the iris and the deeper structures are also liable to be invaded; and deafness is sometimes present. The bones of the palate and nose may be diseased; and nodes may appear in various situations. The fingers and toes also, and, more rarely, the metacarpal and metatarsal bones may become enlarged (dactylitis). This affection is most common in early life; but it has been observed after puberty, as well as in connection with acquired syphilis. The soft palate and pharynx are often the seat of ulceration. The deeper tissues and the vis-

cera are also liable to be attacked by processes similar to those which occur in the acquired disease, giving rise to a variety of symptoms, and sometimes leading to a fatal issue. Some authors, Mr. Hutchinson for example, believe that early life may be passed without symptoms, and that these later affections may constitute the first signs of inherited taint.

Course, Duration, and Terminations.—The course of syphilis varies very much, according to the individual, and according to the treatment adopted. In the majority of cases the disease runs its course in a year and a half or two years; but in certain rare cases it appears to end with the first exanthem; sometimes, perhaps, even earlier than this. When tertiary symptoms ensue, the commonest period for their appearance is probably about five years after contagion; but they may be delayed for ten or twenty years, or even longer. On the other hand, as has been already stated, the secondary may run on into the tertiary stage without any appreciable interval. When tertiary symptoms have once appeared, the duration of the disease is very uncertain, depending greatly on the habits and constitution of the patient, and on the effects of treatment. In some cases the patient continues to suffer throughout his life.

The most usual termination of acquired syphilis is recovery, and this in many cases without treatment, if the patient suffer only from the more superficial forms of disease. In syphilitic disease of the viscera the termination is frequently fatal.

In *inherited syphilis*, if the child be born with signs of syphilis, it usually dies; but when it remains healthy for some weeks after birth, the disease not unfrequently ends in recovery within a year, provided proper treatment be carried out. In later childhood, however, or in adolescence, further symptoms may develop; in which case the duration and termination will depend greatly upon their due recognition and appropriate treatment. When the disease is neglected, death is a frequent termination, especially among the ill-fed children of the poor.

The course and duration of syphilis are also influenced by many other causes, for example, climate, age, idiosyncrasy, pregnancy, and the hygienic surroundings of the patient.

The greater or less severity of the disease, or the stage at which it may have arrived in the person from whom it is contracted, does not appear to have any appreciable influence on the course of acquired syphilis, but the children of syphilitic parents usually suffer more or less severely, according as the infection of the parent is recent or of long standing.

Complications.—*Phagedæna* is an occasional complication of the initial lesion, but more frequently of the later ulcerating syphilides. The *local chancre* is a frequent complication, giving rise to what has been termed the 'mixed chancre.' *Erysipelas* sometimes attacks syphilitic patients, and is said to act beneficially in causing the disappearance of certain obstinate eruptions. This influence, however, is only seen in some chronic cases when the patient is otherwise in fair health. If erysipelas attack a cachectic person, with rapidly spreading lesions, the complication is a serious one and not infrequently proves fatal. In *scrofulous* patients syphilis is often very obstinate and severe, and the skin-affections in such persons are very prone to ulcerate. In *tuberculous* subjects syphilis is apt to rouse the constitutional disease into activity. The *gouty* diathesis also greatly influences the course of syphilis. The skin-eruptions in such cases often assume the scaly form, and resist treatment obstinately. *Bright's disease* is a very serious complication. Patients whose kidneys are diseased are very liable to suffer severely, both as regards the superficial tissues and the internal organs. *Alcoholism* is detrimental in two ways: first by its injurious influence on the system generally; secondly, by preventing the proper action of specific remedies.

Diagnosis.—In the diagnosis of syphilis much will depend on the stage at which the disease has arrived when the patient comes under observation. Before the incubation-period has come to an end the diagnosis will of course be impossible; but when the initial manifestation, with its accompanying glandular enlargement, has appeared, there is usually no difficulty, unless some local complication be present. The initial sore is distinguished by its indurated base, the indolent superficial character of the ulceration, the thin serous discharge which is not inoculable on the patient himself, and the indolent painless enlargement of the nearest group of lymphatic glands. The points of difference between the initial lesion of syphilis and the local chancre are considered elsewhere. *See* Venereal Sore.

The diagnosis of the early exanthem does not, as a rule, present much difficulty, if the general characters of the eruption already mentioned be attended to. In some cases, however, where pyrexia and general constitutional disturbance precede the outbreak of the eruption, the symptoms may, for a short time, be mistaken for those of some other disease. Syphilitic roseola has been mistaken for measles, and a vesicular syphilide for small-pox. In doubtful cases, careful attention to the temperature, and the condition of the tongue, throat, and air-passages, together with the presence or absence of other signs of syphilis, will decide the question in a few days.

It is, however, at a later stage—perhaps many years after contagion, and long after the disappearance of outward signs of the disease—that the diagnosis presents most difficulty to the physician. For example, a patient comes with obscure symptoms, pointing to some lesion of the nervous centres, lungs, liver, or other viscus. In such cases the skin and mucous membrane, particularly that of the mouth and throat, should be carefully inspected, and the more superficial bony surfaces examined for irregularity or thickening. The eyes may afford important aid, by the detection of iritic adhesions or changes in the deeper structures. The presence of local paralyses, especially of the ocular muscles, is a valuable diagnostic sign. The absence of signs or characters distinctive of other diseases—cancer or tubercle, for example—is often also of value in doubtful cases.

When no conclusive information can be gained

from any of these sources, the history becomes of the greatest importance. A venereal sore with lumps in the groins, and followed by a rash on the skin, sore throat or tongue, loss of hair, pains in the bones worse at night, and bad eyes, are some of the points that should be inquired into, and in women the occurrence of abortion or of still-births.

In investigating the history of a supposed syphilitic person, especially if the patient be a woman, it should be borne in mind that syphilis is not necessarily a venereal disease, and that the early manifestations in women may be so slight as to escape observation. Again, some may have forgotten that they have suffered from earlier signs, and others who do remember obstinately conceal the fact. However this may be, the practitioner frequently fails to elicit any history of earlier manifestations in those who suffer from visceral syphilis. Sometimes also, for various reasons, the history cannot be enquired into. If neither the symptoms present at the time, nor inspection of the patient's body, nor the method of exclusion, nor the history of the case, separately or combined, suffice to render the diagnosis clear, specific remedies should be administered, and their effect awaited before a positive opinion is given.

In the diagnosis of *inherited syphilis* at an early stage, the snuffling and coryza, which are often present, are characteristic. The radiating cracks around the mouth and nostrils are also valuable signs. Mucous patches again are nearly always present about the mouth, anus, or genital organs. Pemphigus of the palms or soles is nearly always syphilitic, but it is comparatively rare. Enlargement of the spleen is also a valuable corroborative sign. The bones of the skull, the humeri, and tibiæ should always be examined for osteophytes or epiphysial enlargement. It must be remembered also that a syphilitic child sometimes retains a healthy appearance throughout.

In later childhood the most valuable diagnostic signs are the low stature and puny development; the peculiar condition of the teeth; the dull, pasty complexion; radiating scars about the mouth; the sunken bridge of the nose; signs of present or past mischief in the cornea, iris, or choroid; nodes on the bones; unhealthy ulceration or its scars, especially of the face or throat. Here, again, if no conclusive signs be present, the history becomes most important, both of the patient himself and of his parents, and here also the diagnosis has occasionally to be postponed until anti-syphilitic remedies have been administered.

Prognosis.—This, in the great majority of cases, is favourable, if the patient be otherwise in good health, of temperate habits, and especially if his disease be properly treated at an early period. The effect of other constitutional diseases has already been indicated among the complications of syphilis. Probably nothing tends more to prolong and aggravate the course of syphilis than habits of drinking. In persons given to alcohol, therefore, the prognosis should always be guarded.

A very interesting question, and one on which further information is much needed, is whether any trustworthy data as regards prognosis can be gained from the character of the early manifestations. Neither the length of incubation, nor the amount of induration or ulceration of the initial lesion, has been shown to afford any reliable evidence as regards prognosis. Early *general* glandular enlargement is often an unfavourable sign. Persons thus affected become anæmic, and consequently more liable to grave affections. As regards the early syphilides, it may be mentioned that the ordinary general macular and papular eruptions appear to be less common precursors of late visceral affections than early rashes that are ill-marked and scanty. Obstinate, frequently recurring, but superficial lesions of the skin and mucous membrane also are rarely associated with visceral disease. In connection with this may be mentioned the frequent failure of the practitioner to elicit any history of early symptoms in those who suffer at a later period from grave visceral affections, especially from syphilis of the nervous system.

In the cases of malignant or galloping syphilis, in which ulcerating and rapidly spreading lesions attack the skin and mucous membranes, and are associated with a tendency to phagedæna and great prostration at an early period after infection, the prognosis is grave; the patient may die worn out by the pain and profuse discharge of the superficial lesions, or of some acute affection. Again, if a patient be once proved to have visceral disease due to syphilis, his future is usually a precarious one, and as a rule the duration of life is greatly curtailed.

Finally, one of the most important points to be considered in prognosis is the way in which the patient has been treated. For, although we do not yet know any certain sign which proves that syphilis has come to an end, it may with much confidence be stated that if mercurial treatment have been begun at an early period of the disease, and continued a sufficient length of time, and if the patient be constitutionally robust and of temperate habits, the chances are greatly in favour of complete subsidence of the disease within two years after contagion.

There remains, however, a class of cases, fortunately rare, in which anti-syphilitic remedies cannot be borne—in which indeed they appear to be harmful. In such persons the prognosis is unfavourable, for unless the disease run a mild course, a fatal result is common within a few years, either directly from syphilis, or indirectly from some intercurrent affection.

Much of what has been said as to the prognosis of acquired syphilis applies also to the inherited form of the disease. A child in whom symptoms do not appear until several weeks after birth, who is well cared for, properly fed, and who receives proper medical treatment, will probably recover; one who is ill-fed and neglected will most probably die. Indeed, among the children of the poor, syphilis is one of the most fatal diseases of infantile life.

Treatment.—**1. Preventive Treatment.**—The measures adopted by Government for preventing the spread of venereal diseases are noticed elsewhere. *See* Public Health.

Among individuals the strict daily observance of cleanliness, too often neglected by both sexes

constitutes the best protection against disease. Certain mechanical contrivances are sometimes effective in preventing contagion, but they are untrustworthy. The free use of soap and water immediately after intercourse is probably as effectual as any other application.

Every person who contracts syphilis should be warned of the danger of communicating it to others. Sexual intercourse should always be prohibited while the disease remains active. This direction should never be omitted, as many patients are unaware that they are liable to communicate the disease after the initial manifestation has healed.

The contagious nature of the lesions of the mouth and throat should also be pointed out, and the consequent risk of contagion by kissing, or by the use of drinking-vessels, towels, or other articles in common with other persons.

The question of *marriage* in relation to syphilis is one of great importance, and it is the obvious duty of the physician to prevent the contamination of a healthy spouse, or the procreation of syphilitic children, whenever it is in his power to do so. No person who shows obvious signs of syphilis should be permitted to marry, however long a time may have elapsed since contagion; for although communication of the disease is rare after several years have gone by, it may take place after ten years, or even longer in neglected cases. It has already been stated that syphilis usually ceases to be active within two years after contagion; but this is not always so. Hence, after the last symptoms have disappeared, there should be an interval of at least a year before marriage takes place. Consequently, the shortest period between contagion and marriage should be three years. If the treatment during the early stages have not been systematic and prolonged, it will be prudent to subject the candidate for marriage to an assiduous course of mercury for at least three months, and after this he should be kept under observation for a year before he is allowed to marry. During this period a course of bathing in warm sulphur springs is sometimes useful; for if the poison be still active, the stimulus of the sulphur may hasten the development of the symptoms. This test, however, is by no means reliable.

The spread of syphilis from children to wet nurses, and *vice versâ*, is not so common in this country as abroad; but the physician should never allow a syphilitic child to be entrusted to a healthy wet nurse, nor a syphilitic nurse to suckle a healthy child.

2. **Therapeutic Treatment.**—The treatment of syphilis may be divided into (*a*) *general*; (*b*) *special*; and (*c*) *local treatment.*

(*a*) *General treatment.* — Syphilis is essentially a debilitating disease, hence it is most important that the general health of the patient should be supported by nourishing diet, good air, warm clothing, extreme moderation as regards alcoholic liquors, cleanliness, cheerful society, and moderate exercise in the open air. In nearly all cases the patient should follow his usual employment, in order that his mind may be diverted from dwelling on the slow progress of his cure. The skin should be stimulated to act freely, by the frequent use of soap and water, and an occasional Turkish bath if thought desirable. Flannel should be worn next the skin, and sudden chills avoided as much as possible. Smoking in moderation may be allowed, as long as the mouth and throat remain free; but when syphilitic lesions are present, it should always be discontinued. Regular action of the bowels is also important. Exercise, short of fatigue, should be taken daily, unless the weather is very bad.

(*b*) *Special treatment.* —Besides attention to the general health of the patient on ordinary principles, the administration of certain drugs which are known to have special influence over syphilis should never be omitted, however mild the earlier manifestations of the disease may be. For although syphilis tends in most cases to subside spontaneously, it does not do so in all; and in the present state of our knowledge we have no certain means of distinguishing at the onset the cases which will get well, from those in which tertiary symptoms will follow. There is also much evidence to show that when proper and sufficient treatment has been carried out in the earlier period, the danger of later manifestations is much less than in cases that have been untreated, or treated only by ordinary means. Again, in many of the gravest cases of visceral syphilis there is an absence of any history of early signs, showing that they must have been so slight as to have been overlooked, and consequently untreated.

The two special drugs now almost exclusively used in the treatment of syphilis are *mercury* and *iodine*. Of these the former only can be looked on as a real and permanent remedy. Iodine is of the greatest value in dispersing the later manifestations of syphilis, and is also useful in many cases at an earlier period, but its effects are not lasting, and therefore the iodides cannot be trusted to alone.

Much of the prejudice against the use of *mercury* has arisen from the fact that in former times its administration was carried to a poisonous extent. It is now known that salivation is hardly ever necessary, and that if the drug be properly administered in small doses, it acts as a tonic, syphilitic patients rapidly improving in health and gaining weight under its use.

As soon as induration at the site of contagion, and multiple indolent enlargement of the proximate lymphatic glands, make the diagnosis of syphilis certain, mercury should be given. For all the general symptoms of the secondary stage, also, mercury is appropriate. And in the later stages it should be used in conjunction with iodine, or to complete the cure after the symptoms have been dissipated by iodine, or in cases where the iodides fail to relieve. In fact, there is no stage of the disease at which mercury may not be administered with advantage in many cases. It may be given to almost all persons when its use is indicated, but its effect must be carefully watched if the patient be in very feeble health, or the subject of disease of the kidneys.

Before a mercurial course is begun the mouth should, as far as possible, be put into a healthy condition. Unsound teeth should be stopped or removed, and tartar got rid of. If the gums are

spongy, an alum mouth-wash should be used frequently.

Mercury should be given more or less continuously for at least a year after contagion. If symptoms be present at the end of that time, treatment should be continued for at least three months after their disappearance. During this period it will of course be necessary to omit the mercury from time to time, or to vary the form of the drug, according to the peculiar circumstances of each case.

In small doses mercury is a tonic, and the aim should be to limit its action as much as possible to the tonic effect. When taken in syphilis the patient usually improves rapidly in health. If a rash be present it soon begins to fade, and ulcerated surfaces begin to heal. All the useful effects of the drug are usually attained when only the slightest effect is produced on the gums.

Mercury may be introduced into the system in various ways—by the stomach, rectum, vagina, skin, or subcutaneous cellular tissue, but its action is essentially the same by whatever channel it is administered.

In the majority of cases mercury may be most conveniently given internally in pills, or in a mixture; but it is sometimes used in the form of suppository. This, however, frequently gives rise to irritation. In early syphilis blue pill, or grey powder, usually fulfils all the requirements of the case. If no urgent symptoms be present, 1 or $1\frac{1}{2}$ grain of either of these preparations may be given, with a little extract of gentian, three or four times a day, at or immediately after meals. Quinine or reduced iron may be added, if thought desirable. In such small doses mercury rarely disagrees, and opium is unnecessary. If, however, a rapid effect be desired—in iritis, for example—2 or 3 grains of blue pill, with $\frac{1}{4}$ or $\frac{1}{3}$ grain of opium, may be given three or four times a day until the requisite effect is produced, after which the drug may be given less frequently, or be reduced in quantity. If the milder degrees of salivation be inadvertently set up, the mercury should be discontinued for a few days, a purge administered, and the mouth washed out frequently with an alum or chlorate of potash gargle. *See* SALIVATION.

The green iodide of mercury is more liable to decomposition, and to cause irritation than the forms just mentioned. If preferred, it may be given in doses of $\frac{1}{4}$ to 1 grain, with a little opium, twice or thrice a day.

The perchloride is mostly given in the later and more chronic forms of syphilis, when only a mild action is required. It may be prescribed in doses of $\frac{1}{16}$ to $\frac{1}{8}$ grain, either in a pill with sugar of milk, or in a mixture with iodide of potassium or with tincture of iron, according to circumstances.

When other preparations disagree, the bicyanide may be given. The red iodide is also often useful, especially in cases of relapsing scaly syphilides.

A preparation of mercury with sarsaparilla and aromatics, known as *Zittmann's decoction*, is sometimes useful in tertiary syphilis.

*Subcutaneous injection* of mercury is very effective and speedy in action; but it is painful, and requires daily medical attendance. Hence it is only to be recommended when other means fail, or in urgent cases. The solution known as Ragazzoni's (containing the red iodide) is one of the most useful preparations.

*Inunction* is also very effective, but it is dirty and troublesome to the patient; hence he often neglects to carry it out properly. It may be employed whenever mercury is indicated, 20 to 60 grains of mercurial ointment being rubbed in every night, or every other night, as required.

The *mercurial vapour bath* is very beneficial in certain cases, especially those of wide-spread rash. From 20 to 40 grains of calomel is the usual quantity for each bath.

The *iodides* are principally used in the treatment of the lesions usually called tertiary. In the later stage of the secondary period, and in cases where the lesions partake of the characters of both stages, the iodides may often be advantageously combined with mercury.

In all cases where the symptoms have been controlled by iodine, mercury should be given to complete the cure.

*Iodide of potassium* is the salt most frequently used; but the iodides of sodium and of ammonium are also employed, and may be used if the former disagree. The action of all is very similar, but the sodium appears to be less depressing than potassium, while the ammonium salt is stimulating. The dose of the iodides varies from 2 or 3 to 100 grains or even more. It is best to begin with 3 or 4 grains, with a little ammonia, three times a day, and to increase the dose if necessary. In urgent cases of visceral disease, and particularly in syphilitic affections of the nervous system, 20 grains may be given at first, and the dose rapidly increased to an almost unlimited extent until some effect is produced. In such cases, also, it will often be prudent to carry out inunction, or the subcutaneous injection of mercury, at the same time. The iodides should be given in a large quantity of water; and any of the bitter infusions, or tartarated iron, may be added when their use is indicated.

*Iodoform* is occasionally given internally in the later stages of syphilis; but it frequently causes so much gastric and intestinal irritation that it cannot be borne. The dose is about a grain, in the form of pill.

The *bromides of potassium and ammonium* are serviceable when the patient has become insensible to iodine, and in certain cases of affection of the nervous system. They may be given alone, or with iodide of potassium.

Besides the foregoing remedies many others, especially tonics and sedatives, may be required in the treatment of syphilis. Iron, for example, is frequently beneficial, either in conjunction with specifics or with quinine, or in the form of the iodide. Cod-liver oil also is very valuable in many cases. Sarsaparilla is sometimes beneficial in enabling the patient to bear large doses of iodide. It is also often useful during or after a prolonged course of mercury. Mineral acids and vegetable bitters are often of service during the intervals of specific treatment. Opium is of great value in many of the affections produced

by syphilis—phagedæna and periostitis, for example.

Certain bathing resorts which possess *sulphur* springs—Aix-la Chapelle, for example—have become noted for the cure of syphilis; and there can be no doubt that great benefit is often derived from the course of treatment pursued at such places. The good results, however, appear to be due more to a combination of specific remedies and diaphoresis, with strict attention to diet and general hygiene, than to any special virtues of the waters themselves.

When syphilis is complicated with scrofula, gout, rheumatism, &c., the appropriate remedies should be given with those proper for syphilis, or temporarily substituted for them according to circumstances.

(*c*) *Local treatment.*—The initial lesion usually requires only cleanliness, and the application of wet lint. If it be indolent, black wash, or a lotion of sulphate of zinc, or other mild astringent, may be applied. If the sore suppurate, either through neglect or from the presence of the virus of the local chancre as well, the surface should be cleaned, dried, and dressed with finely-powdered iodoform. *Phagedæna* must be treated by immersion, caustics, or the actual cautery, while the general health receives attention (*see* VENEREAL SORE). If the lymphatic glands become tender or inflamed, warm fomentations should be applied, and the patient kept lying down. If abscess form, it must be treated according to the directions given in the article on BUBO.

The early *syphilides* rarely require local treatment. *Erosions* or *fissures* may be dressed with an ointment of calomel and vaseline, or with iodoform. Indolent or unhealthy sores, especially in weakly persons, are often benefited by a lotion of tartarated iron. In the scaly affections of the palms and soles, an ointment of ammoniated mercury, oxide of zinc, and vaseline may be well rubbed in at bedtime, and gloves worn during the night. Mercurial plaster also is often a very useful application. *Mucous patches* should be cleansed and dried several times daily, powdered with calomel or oxide of zinc, and covered with dry lint. If they become very large and prominent, solid nitrate of silver or acid nitrate of mercury may be applied. Cracks and ulcers about the *nails* should be dressed with mercurial plaster, or with red oxide of mercury ointment.

*Ulcers or fissures, or mucous patches of the lips, tongue, mouth, and throat* should be touched every other day with nitrate of silver, or sulphate of copper, and an alum or borax wash used frequently, especially after eating. For the later ulcers soothing applications should be used, but internal treatment is of the greatest importance in such cases.

*Ulcers and chinks about the nostrils* should be kept moist with red oxide of mercury and vaseline ointment. When *necrosis* of the nasal or palatal bones has occurred, a lotion of permanganate of potash or chlorinated soda should be used with the nasal douche, and the fragments removed as soon as they become loose. The early affections of the *larynx* usually disappear without local treatment. In the later affections tracheotomy may be necessary.

*Ulcers of the anus* require careful cleansing and the application of calomel or iodoform ointment. For *ulceration within the rectum* iodoform suppositories and astringent injections should be used. In *stricture of the rectum* careful dilatation by means of bougies should be tried. In extreme cases rectotomy, or even colotomy, may have to be performed.

As regards *the bones*, the pain produced by early nodes is relieved by painting with a solution of iodine, and by blisters. Nodes should never be opened. If necrosis take place, the dead bone should be removed as soon as it becomes loose.

In *iritis*, besides the prompt administration of mercury, a solution of sulphate of atropine (4 grains to the ounce) should be dropped into the eye every two hours till the pupil is well dilated. Afterwards a weaker solution may be used to keep up the effect. In *interstitial keratitis* also atropine should be used. Iridectomy is occasionally necessary. In *choroiditis* and *retinitis* repeated leeching is sometimes useful when there is much pain, but constitutional treatment is most important.

In syphilitic *orchitis* a suspensory bandage should be worn, but other local treatment is usually unnecessary, unless the gumma break down and fungous protrusion occur, in which case support should be given by strapping. In *syphilitic affections of the uterus* frequent injections of borax or sulphate of zinc are required, and in case of ulceration, iodoform or caustics are sometimes necessary.

**Treatment of Inherited Syphilis.**—*Preventive treatment.*—If a syphilitic husband have a relapse before his wife becomes pregnant, he ought at once to desist from sexual intercourse—indeed from contact of every kind, and undergo treatment. The wife also should be watched, that treatment may be begun as early as possible, if she have contracted the disease. If the wife become pregnant while the husband shows signs of syphilis, both parents should be treated with mercury.

*Treatment of the child.*—Mercurial treatment should always be adopted as soon as symptoms appear. Grey powder may be given in one-grain doses twice a day. But a strip of flannel smeared with diluted mercurial ointment, and worn round the waist, is preferable. The ointment should be renewed every night, and the skin cleansed every third day. Syrup of the iodide of iron and cod-liver oil may also be given. Treatment should always be continued for at least six months; and, if symptoms be then present, until their disappearance, and for several months afterwards.

Iodide of potassium is most valuable in the later forms of disease. The rules for its employment are the same as in acquired syphilis, but the dose must of course be smaller.

The *local treatment* of the syphilitic affections of children is similar to that recommended for adults. When the nostrils are obstructed by inspissated mucus, they must be carefully cleansed with a camel's-hair brush, and the excoriations touched with red oxide of mercury ointment.

The *general management* and *diet* of syphilitic children are most important. Whenever the mother can suckle her child, she should always

do so. If this be impossible, a syphilitic wet-nurse is the best substitute. If neither be available, ass's, goat's, or cow's milk must be given. Extreme cleanliness and fresh air are essential. As the child grows older, the method of feeding must be conducted on ordinary principles. ARTHUR COOPER.

**SYRINGOMYELIA** (*σύριγξ*, a cavity, and *μυελός*, the marrow).—This is a name under which Ollivier grouped numerous cases in which cavities of different kinds were met with within the substance of the spinal cord. For a reference to the nature of these cases, *see* SPINAL CORD, Special Diseases of, No. 21, Malformations.

**SYSTOLIC.**—Of or belonging to the systole or contraction of the heart, and usually associated with the cardiac impulse or sounds, or with murmurs. *See* PHYSICAL EXAMINATION.

# T

**TABES** (*tabes*, a consumption).—A term formerly employed to denote consumption or wasting of the body.

**TABES DORSALIS** (*tabes*, a consumption, and *dorsalis*, spinal).—A name formerly applied to a condition of debility caused by excessive sexual indulgence, and characterised especially by failure of nervous power. The term is now used as synonymous with locomotor ataxy. *See* LOCOMOTOR ATAXY.

**TABES MESENTERICA** (*tabes*, a consumption, and *mesenterica*, mesenteric).—A wasting disease caused by tubercular or scrofulous affection of the mesenteric glands. *See* MESENTERIC GLANDS, Diseases of.

**TACHE** (French).—A spot or patch. The word is most frequently used in connection with morbid conditions of the skin. *Tache cérébrale* has been specially applied by Trousseau to a patch or streak of hyperæmia, produced by irritating the skin in certain cases of cerebral meningitis. *See* MENINGES, CEREBRAL, Diseases of.

**TÆNIA.**—SYNON.: Tape-worm.—A genus of cestode entozoa, characterised by the possession of a head furnished with four sucking disks; also by having reproductive papillæ either uniserially or biserially disposed along the lateral margins of the segments of the body. Strictly speaking, a tapeworm is a colony of incomplete individuals (called *zooids* or *proglottides*) arranged in single file, the uppermost zooid being transformed into an organ of anchorage, which is popularly called the *head* of the parasite. Several species of this genus occur in man, the two most common forms being the beef-tapeworm (*T. mediocanellata*) and the pork-tapeworm (*T. solium*). A third has been indicated by the writer as the mutton-tapeworm (*T. tenella*), but at present it is only imperfectly known. *See* HYDATIDS; and TAPE-WORMS.

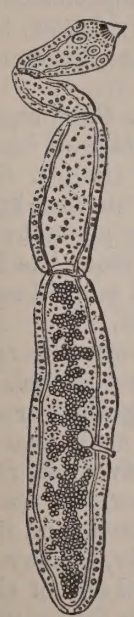

FIG. 89. *Tænia Echinococcus.* Origin

FIG. 90.
Unarmed Head of *Tænia mediocanellata*; × 10 diam. After G. Fritsch.

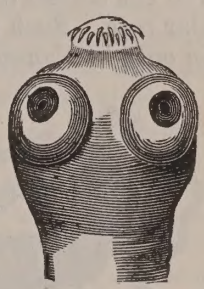

FIG. 91.
Armed Head of *Tænia solium*; × 10 diam. After G. Fritsch.

FIG. 92.
Proglottis of *Tænia mediocanellata*; × 1½ diam. After G. Fritsch.

FIG. 93.
Proglottis of *Tænia solium*; × 1½ diam. After G. Fritsch.

T. S. COBBOLD.

**TANGIERS.** *See* MOROCCO.

**TAPE-WORMS.**—SYNON.: Fr. *Tænia*; *Ténia*; Ger. *Bandwurm.*—Under the heading *Tænia* the zoological characters of these parasites are given. Besides *Tænia mediocanellata* and *T. solium* the human body may be attacked by several other species, some of which, however, are only imperfectly known (*Tænia lophosoma, T. tenella,*

*T. elliptica*, *T. flavopuncta*, *T. marginata*, *T. nana*, *Bothriocephalus latus*, *B. cordatus*, and *B. cristatus*). Practically, in treating cases it matters little which form we have to deal with, except in so far as the complete expulsion of the worm is rendered difficult or otherwise. This varying result depends in a great measure upon the character of the species. Those tape-worms which are armed with hooks, in addition to powerful suckers, are more difficult to dislodge from the intestines than are those species which are unarmed. The prognosis is therefore always more favourable in cases of the beef-tapeworm and the ordinary pit-headed worm, than in cases of the pork-tapeworm. In so far, however, as the mere selection of drugs is concerned, the remedies that suffice to expel the one kind are equally suitable, as poisons, for the expulsion of the other. Unquestionably, the ability to recognise the various species of tape-worm liable to be encountered in practice is a great help in the general management of cases; and also, more particularly, in forming an opinion as to the correct mode of dealing with any particular case. Such means of diagnosis, however, can only be thoroughly acquired by careful study

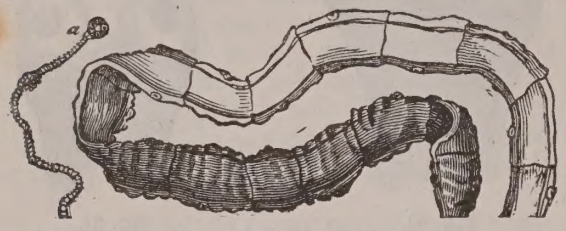


FIG. 94. Head (*a*); and several segments of *Tænia mediocanellata*; reduced from the natural size. After Owen.

of museum specimens, aided by the descriptions given in standard works on helminthology. Whilst it is a comparatively easy matter to recognise the *head* of any form of tape-worm, and thus to pronounce upon the nature of the species, the recognition of the true source and character of the entozoon is not so readily made, by inspection of fragments of the so-called body of the parasite. All kinds of mistakes are continually occurring in practice from a want of exact knowledge of this sort. The writer has had brought to him many foreign bodies that were erroneously regarded as links (joints, segments, cucurbitini, or proglottides) of tape-worms; and he has also known instances where true fragments of the worm were mistaken for ascarides. The result of such errors has been that the supposed victims had been undergoing treatment, more or less vigorous and prolonged, when there never had been any tape-worm present. No doubt, partly from the distaste for the subject of parasites generally, partly from the circumstance that the management of cases has long been relegated to quacks and other unqualified and ignorant persons, and partly also because some have taught that the diagnosis and treatment of tape-worm is a very commonplace and simple matter—too simple, in fact, to need special lectures at our medical schools—partly, we say, from these and other minor considerations, the subject has never received that measure of attention which it demands.

SYMPTOMS.—The symptoms occasioned by the presence of tape-worm are extremely variable, both in character and degree. The bearer may be little inconvenienced, or he may suffer severely. He may experience only feelings of weariness and lassitude, which, in some cases, are set down to other causes than tape-worm. In young persons not even these feeble indications may be present. In grown persons, however, sooner or later a general loss of health commences; the processes of digestion are interfered with; and the patient becomes anæmic, irritable, and restless at night. There is headache, accompanied by vertigo. The sight and hearing become affected; noises in the head, local irritation at the nose and anus, dyspepsia, and obscure pains about the limbs and body, present themselves in a greater or less degree. The patient often feels faint, and finds it necessary to obtain artificial support. In the worst cases various sympathetic phenomena make their appearance, but in the female they are not so grave as in the male, commonly developing as hysteria and chorea. Occasionally, however, in both sexes, there may be paralysis with or without epileptiform seizures. Cases of insanity from tape-worm are reported by Winslow, W. Wood, Ryan, David Ferrus, Féréol, and many others. In one instance mania of eight days' duration was cured by expulsion of the worm. Cases of convulsions, often accompanied by peculiar symptoms, are not infrequent, but they usually do well. Affections of the eye, such as amaurosis and squint, have also yielded to appropriate vermifuges (Burgiss; Streatfeild). In Dr. Davaine's invaluable treatise a variety of singular nervous cases are given. Amongst these we may particularise Leroux's instance of spasmodic phenomena in a girl of nineteen; Legendre's case of strange convulsive phenomena in a man twenty-seven years of age; Quettier's instance of periodic trembling; and especially Billard's case of voracity, accompanied by maniacal symptoms. Happily in all these severe cases the evacuation of the worm was followed by restoration to health. This is the usual result; but in those instances where the worm redevelops itself the symptoms are apt to return. It does not necessarily follow, however, that the identical sympathetic phenomena will again make their appearance.

PROGNOSIS.—On the whole, the prognosis is favourable. In a small percentage of cases tape-worm proves dangerous to the victims. Some infested persons, rather than let another know the fact, will privately endure any amount of inconvenience, such as daily arises from the frequent passage of proglottides. Such morbid sensitiveness is uncalled for and unwise.

TREATMENT.—As regards drugs the resources are ample. We have turpentine, kousso, kamala, panna, pumpkin-seeds, pomegranate root-bark, areca nut, and last, not least, male fern; not to mention some of the older favourite remedies, such as calomel, oxide of silver, tin, scammony, cowage, jalap, and a host of drastic and injurious purgatives. Speaking generally, it may be said that the right administration of any of the comparatively modern remedies is likely to be attended with success, at least as regards the expulsion of the body of the parasite. In the writer's judgment, based upon a lengthened ex-

perience, no remedy is equal to male fern, for he has found the ethereal extract of this root effective in cases where the employment of nearly all the other remedies had failed. On the other hand, Dr. Fock speaks of the infallible effects of pomegranate root bark (*De Lintworm en het middel om hem mit te drijven*, Utrecht, 1873). In the country districts of England the favourite remedy is turpentine, but its employment is gradually giving way to that of male fern. Without doubt, the oil of turpentine is an excellent tæniafuge; yet its nauseous character (except in capsules), combined with the well-known fact that it not unfrequently produces strangury, besides other irregular effects, should render practitioners cautious in its employment. To a certain extent the use of the male fern oil or extract is open to objection on the score of its nauseous taste; but this disadvantage is more than counterbalanced by the smallness of the quantity required for a dose. In only one instance has the writer seen this drug *persistently* rejected by the stomach. To obviate this inconvenience a variety of extracts have been prepared by pharmaceutists. The writer has tried several of the vermifuge extracts, such as kousso, kamala, male fern, but finds none equal in power to the oil of male fern. M. Heckel has sought to ascertain the active part of pumpkin-seeds, and he found that it resides in the outer membrane surrounding the embryo (*Lancet*, 1875, vol. ii.). In two cases in which he administered this membrane the tapeworm was expelled entire. M. Heckel believes the active agent to be a resin, and he thinks that castor oil, which in the cases in question was given both before and after the remedy, acts favourably, not merely by its purgative properties, but also in virtue of its power of dissolving the resin.

Success in the result depends, not so much on the choice of the tæniafuge, as upon the mode of administering it, and of observing the results accurately. In nine out of ten cases it is taken for granted that all is right, if the patient has only stated that, after taking the medicine prescribed, he got rid of several yards of the worm. The writer has heard of an instance where the patient alleged that he passed a single tapeworm which measured 100 yards. Of course it is quite conceivable that a person may be the victim of half-a-dozen or more tape-worms at a time. Twelve full-grown tape-worms, each 25 feet in length, would collectively give an admeasurement of 100 yards; but the writer has never yet found proof of the occurrence of more than four perfect tæniæ in one and the same human bearer. Such an instance has been recorded by Mr. Welch in his admirable memoir on the anatomy of *T. mediocanellata* (*Quarterly Journal of Microscopic Science*, 1875). On several occasions the writer has had patients suffering from more than one tape-worm, and in one instance, where there were two, both *heads* were expelled at one and the same time. Küchenmeister refers to numerous alleged instances of the occurrence of several tape-worms in one host, quoting, amongst others, that by Madame Heller, who, it is said, encountered as many as forty in one patient. We take upon ourselves to say, that in most, if not in all, of these so-called multiple tape-worm cases, the various broken fragments of one or two large parasites have been reckoned as representing so many different worms. Not infrequently foreign bodies resembling segments of tape-worm are regarded as so many parasites, and the cases are treated accordingly. In the management of genuine cases it is most important that the *head* should be secured. This minute structure is very frequently detached separately from the body, and it is still more frequently left adhering to the mucous membrane of the small intestine, when the greater part of the body of the worm has been expelled. It rarely happens that either a nurse or a patient has any notion as to what the head of a tape-worm is like, and we fear that many practitioners are in the like case. For this want of knowledge there is really no excuse; nevertheless we have heard it laid to the charge of our clinical teachers that they have never afforded the necessary instructions on this subject. Be that as it may, the writer has for many years past insisted on a more thorough examination of the fæces following upon the administration of vermifuges. Only in exceptional instances does the head of the worm remain attached to the unbroken strobile or tape-worm-colony. In such cases a nurse, or the patient himself, may remove the head and bring it with the body to the practitioner. In the majority of cases the body of the worm breaks off at the base of the neck, but frequently also at the upper and narrower part, about an inch from the head, more or less. Occasionally the rupture takes place at the base of the head, leaving nothing but the expanded cephalic portion with its suckers (and crown of hooks, if it be an armed species) intact. The writer has recorded an instance in which only the suckers themselves were left after the expulsion of the entire body of the worm had been effected (*Tape-worms*, 3rd edition, case iv. p. 55). In regard to the employment of enemata, as recommended by Mosler, the writer is of opinion that the practice is altogether contra-indicated. If it were true that the once detached head were capable of re-anchoring itself in the lower bowel, as Mosler supposes may be the case, then possibly such injections might be employed with advantage. The notion that a tapeworm could re-develop in such a situation is quite at variance with all that we know respecting the growth and economy of human cestoids.

As regards prescribing, all that we deem it necessary here to say is that caution should be exercised as to the quality and quantity of the drugs administered, and also in respect of the length of time during which the worm-poisons may be given. The writer has witnessed serious results from the persistent use of turpentine and male fern, though the doses themselves were not excessive. He has witnessed toxic effects from one-drachm doses of the male fern extract, when given a few times in succession to adults. In young children half-drachm doses sometimes produce wandering and mental confusion. These unpleasant symptoms are of brief duration, provided the tæniafuges be stopped. In treating young persons with powerful anthelmintics the patients should always be carefully watched, and great care be exercised lest the treatment be injudiciously prolonged. So variable are the

phenomena and experiences encountered, that it is not easy to lay down any precise rules which shall be applicable to all cases. In every instance the practitioner must be guided by the actual result of each day's successive treatment. If he obtain the head of the worm he need not hesitate to pronounce that his patient is cured, unless there be evidence that he has to deal with more than one parasite. This very essential point is not so easy of determination as might be supposed. If the bodies of two or three distinct parasites be broken up by the worm-poison and expelled, it requires very accurate knowledge of the sexually mature and immature proglottids respectively, in order that, by inspection, the practitioner may determine the point in question. All the portions must be carefully removed from the stool and laid end to end, according to the form in which they would present themselves during life. If this be accurately done, then, and then only, can it be said whether the patient has been the victim of one, two, three, or more tape-worms. In the correct management of such cases there is much trouble and labour to be overcome, to say nothing of the exercise of that scientific knowledge which a careful study of the structure and economy of these singular parasites involves. No two cases are exactly alike. In diagnosis, as well as in treatment, various questions present themselves, the correct solution of any one of which may be of importance to the patient. The writer has witnessed serious results from false diagnoses. In one of these maltreated cases the patient, a lady, had undergone six years of persistent drugging by vermifuges, when all this time she was not infested by tape-worm, neither had she at any time previously entertained the presence of any cestode parasite. *See* TÆNIA.

T. S. COBBOLD.

**TAPPING.**—A popular synonym for paracentesis. *See* PARACENTESIS.

**TARANTISM** (*tarantula*, a ground spider). SYNON.: Fr. *Tarentisme*; *Chorée épidémique*; Ger. *Tarantismus*.

DEFINITION.—An epidemic dancing mania, prevalent in Italy in the sixteenth and seventeenth centuries, originating in fear of the bite of the tarantula, as a remedy for which the dance was adopted. A full account of it will be found in Hecker's *Epidemics of the Middle Ages*.

HISTORY.—The Italian dancing mania commenced in Apulia, in the latter part of the fifeenth century, contemporaneously with the St. Vitus's dance in Germany. The ground spider had long been held in dread, as causing, by its bite, symptoms of nervous and physical prostration, which might end in death, or lifelong lassitude. At this period the fear of the frequently recurring epidemics of the Black Death, eastern plague, and other diseases, caused widespread depression. The tarantula was dreaded throughout Italy, and a bite from an unknown source was a ready explanation of any symptoms of nervous prostration. The inspiriting influence of music and rhythmical motion was found to dispel, for a time, the depression, and the theory arose that by this means the poison of the spider was distributed over the body, and expelled through the skin. The nervous excitement of the remedy proved, however, a greater evil than the real or supposed disease. The induced emotion outran control. The dancing became frantic, and was continued until the dancers fell senseless from exhaustion, with the result of leaving them for a time free from the depression. The dancing mania spread by moral contagion, and large numbers of persons, young and old, male and female, became affected. The temporary relief gained by the dance led to the adoption of the remedy at intervals, which ultimately became yearly; and every summer the sufferers grew depressed in anticipation of the advent of the annual dance. Strange psychical conditions were induced by the emotional disturbance; other sensory impressions besides music gave pleasure, and certain colours, such as red, or the sight of the sea or even of clear water, exerted a strange fascination. The sexual passion became involved in the tumult of emotion, and the mental excitement occasionally ended in self-destruction. Of longer duration than the dancing epidemics of Northern Europe, tarantism was at its height in the seventeenth century, and gradually died out in the eighteenth, leaving only a designation for a lively dance as its harmless legacy.

W. R. GOWERS.

**TARASP, in Unterengadin, Switzerland.**—Alkaline sulphated waters. *See* MINERAL WATERS.

**TARTAR EMETIC, Poisoning by.**—SYNON.: Fr. *Empoissonement par l'Antimoine*; Ger. *Antimoniumvergiftung*.—Poisoning by tartar emetic, a soluble double tartrate of antimony and potassium, is not very common. The emetic properties of the salt generally ensure its speedy ejection from the stomach. Poisoning by the salt may be either (1) *acute*, from the ingestion of a large dose; or (2) *chronic*, the patient succumbing under the exhaustion consequent upon its prolonged administration.

1. **Acute poisoning.**—Shortly after taking a large dose of tartar emetic, the patient is seized with intense nausea and faintness, accompanied by depression of the force of the pulse, and increased perspiration. Violent vomiting and retching follow, with a burning pain and sense of constriction in the mouth, throat, and gullet. Vomiting affords no relief to the nausea and pain, and is repeated, the vomited matters becoming bilious, and ultimately perhaps blood-tinged. A metallic taste is felt in the mouth; the abdomen becomes painful and tender; and profuse diarrhœa sets in, the fæces often containing a considerable quantity of blood. The urine is at first increased in quantity; but later it may be scanty, blood-tinged, or suppressed. The circulation is throughout depressed; and the skin cold, clammy, and bathed in profuse perspiration. The muscular system is relaxed; but cramps of the extremities may torture the patient. In rare cases a pustular rash appears, like that produced by the external medicinal application of the drug. In some cases neither vomiting nor purging has occurred, the symptoms being simply those of intense prostration, with embar-

rassed respiration. In fatal cases death occurs within a few hours.

2. **Chronic poisoning.**—The administration of repeated small doses of tartar-emetic causes nausea, vomiting, purging, exhaustion, and debility, which not infrequently prove fatal. These symptoms are accompanied by depressed irregular circulation, profuse perspiration, and disturbances of respiration.

ANATOMICAL CHARACTERS.—These are somewhat variable, but on the whole are those of a metallic irritant poison. In most cases there is inflammation of the stomach and intestinal tract generally, not so patchy nor marked by such bright redness, as in arsenical poisoning. Not infrequently the stomach and small intestines escape, and the inflammation may be confined to the large bowel; even ulceration of the intestines may occur, accompanied by hæmorrhagic extravasations. Hypostatic congestion of the lungs is often prominent.

DIAGNOSIS.—Poisoning by tartar emetic may be diagnosed from other irritants, especially arsenic, by the greater and earlier depression, the profuse perspiration, greater irregularity of pulse, and the more irregular respiration. An analysis of the ejecta or of the urine is always advisable, and often indispensable to complete the diagnosis. In chronic cases an analysis of the urine is the only satisfactory mode of determining the nature of the illness, where tartar emetic is not known to have been administered as a medicine.

PROGNOSIS.—This must always be grave, so long as the ejecta contain considerable quantities of the poison. In acute cases the patient cannot be considered out of danger till not only the vomiting has ceased, but an obvious return of strength has set in for some time.

*Fatal Dose.*—Two grains have proved fatal to an adult. Much larger doses may, however, as a rule, be taken with impunity. The danger is much increased if the poison be taken in conjunction with some substance, such as opium, which deadens the susceptibilities of the stomach.

TREATMENT.—The stomach-pump is seldom necessary, vomiting being very profuse. The elimination of the poison may be hastened by free administration of diluents, and the stomach protected by mucilaginous drinks. The stomach should, however, be washed out by means of the syphon-tube. The most effective antidote is tannin, which forms an insoluble tannate of antimony. For this purpose tincture of cinchona, decoction of oak-bark, or strong infusions of tea or coffee, may be administered; or the stomach may be washed out with similar fluids, or with a solution of half a drachm of tannin. Not till after this has been done, or the stomach well and repeatedly cleansed by free vomiting, should opium be administered. The after treatment will depend upon the symptoms. The treatment of chronic cases consists in cessation of the administration of the poison; in the exhibition of ammonia, stimulants, and tonics; and in careful support of the strength. Nutrient and opiate enemata are of the greatest service.

THOMAS STEVENSON.

**TASMANIA.**—A warm, equable, sub-tropical climate. Mean temperature of Hobart Town, the capital, 54° Fah. Prevalent winds, N.E. and S.W. *See* AUSTRALASIA (in APPENDIX); and CLIMATE, Treatment of Disease by.

**TASTE, Disorders of.** — SYNON.: Fr. *Troubles du Goût*; Ger. *Stöhrungen des Geschmackes.*

Disorders of taste have to be carefully distinguished from disturbance of olfactory impressions, on which all perception of flavour depends. They have also to be distinguished from disturbed appreciation of the sensations of taste—increased or diminished enjoyment of, or disgust at, sensations which are themselves normal.

1. **Increased sensitiveness of the nerves of taste.**—SYNON.: Gustatory hyperæsthesia; *Hypergeusia.*—This condition is evidenced by detection of a substance too minute in quantity to be perceived by normal taste, or by an abnormally intense impression when a given quantity of a substance is tasted. In excitable states of the nervous system, as in general malnutrition, substances in small quantities in the blood are tasted with great readiness; the bitterness of morphia injected beneath the skin may be at once noticed (Wernich), and for long after a bitter substance has been taken, whatever is tasted may seem bitter. Gustatory hyperæsthesia is often met with in hysterical persons, and sometimes in the insane. It is not usually a symptom of sufficient prominence to demand special treatment.

2. **Perverted sense of taste.**—SYNON.: Gustatory paræsthesia; *Parageusia.*—This is not uncommon in neurotic states. Substances excite a different taste from that to which they naturally give rise. A bitter flavour, for instance, is detected in a simple saline. This condition is commonly conjoined with altered appreciation of the taste which is recognised, so that substances commonly considered pleasant are disliked, and those are enjoyed which commonly excite disgust. It is seen in a slight degree in some toxæmic conditions, but more frequently in psychical disturbances. In hysteria it leads to various absurdities in diet.

3. **Subjective sensations of taste.**—These occur sometimes from disorders of the central nervous system, in hysteria, insanity, and occasionally in epileptoid states. The sensation is usually of an unpleasant description, and probably, from its character, is produced in the region supplied by the glosso-pharyngeal nerve.

Subjective sensations of taste occur also, very rarely, from irritation of the gustatory nerves. They have been produced experimentally by galvanising the chorda tympani, when exposed by disease of the internal ear, and have occurred in some cases of disease of the petrosal part of the facial nerve. Irritation of the nerves ending in the tongue by mechanical and electrical stimuli may also cause a sensation of taste. These subjective sensations have to be distinguished from abnormal sensations due to substances in the blood or to secretions of the mouth. The treatment of the symptom is that of its cause.

4. **Loss of the Sense of Taste.**—SYNON.: Gustatory anæsthesia; *Ageusia.*

ÆTIOLOGY.—Diminished sense of taste may

depend (*a*) On thickening or other changes in the mucous membrane of the mouth, rendering the nerve-endings less accessible to sapid solutions. (*b*) On local applications lessening the irritability of the nerve-endings. Hot or cold applications may temporarily destroy the sense of taste. Cool substances cannot be tasted so well as those which are warm. (*c*) On hysterical and other functional nervous disturbances. (*d*) On disease of the nerves which conduct the sensation. There is still much uncertainty as to the nerves concerned in this function. Perception of taste over the posterior, and perhaps also the middle third of the tongue, the soft palate, and the anterior pillars of the fauces, is believed to depend on the glosso-pharyngeal nerve, and to be lost when that nerve is paralysed. It is probable, however, that this is not the case in all persons. The writer has met with an instance of complete unilateral loss of taste on tongue and fauces, in which the fifth nerve was paralysed, and the glosso-pharyngeal was unaffected. Taste in the anterior third of the tongue depends on the gustatory or lingual branch of the fifth, and probably on the fibres it receives from the chorda tympani. Hence destruction of the lingual (section for neuralgia—Inzani), disease of the chorda tympani, and disease of the facial just above the origin of the chorda tympani, have all been followed by loss of taste in the front of the tongue. It is exceedingly common in facial paralysis from rheumatic inflammation of the nerve-trunk, no doubt from the mischief passing up the bony canal as far as the origin of the chorda tympani. Division of the facial nerve outside the skull has also caused loss of taste (Stich; Lotzbeck), and hence it is thought that some fibres from the tongue must reach the facial, by external junction. It is much more probable that migrating neuritis may have passed up the nerve, and have involved the chorda tympani, in these cases. But instances are on record in which no loss of taste has resulted from destruction of the chorda tympani, and hence it is assumed that some gustatory fibres pass from the lingual to the otic ganglion, and thence by the small superficial petrosal nerve, and the nerve of Jacobson, to the glosso-pharyngeal. In these cases it is possible that the fifth nerve may supply the gustatory fibres directly to the front of the tongue. Moreover, the glosso-pharyngeal fibres have been themselves traced by Rudinger to the fore part of the tongue, anastomosing with the twigs of the lingual, and Eulenberg suggests that in some cases they may maintain the function of the latter. As to the path of the gustatory fibres which the chorda tympani conveys to the facial nerve, there is much difference of opinion. Lussana believes that they continue with the facial and, as the 'intermediate part' of that nerve, pass to a nucleus near that of the glosso-pharyngeal. But since disease of the facial nerve within the skull does not, as a rule, cause loss of taste, most authorities consider that the fibres leave the facial nerve in the large superficial petrosal, and thus reach the spheno-palatine ganglion, and, according to Schiff, pass to the brain by the fifth nerve. This view is supported by the case just mentioned and by one recorded by Hirschberg, in which disease of the fifth within the skull caused loss of taste in the front of the tongue. In other cases of disease of the fifth there is no loss of taste (Lussana, Renzi, Althaus); but this is not decisive, since, as just observed, the extensive distribution and connection of the glosso-pharyngeal nerve may permit vicarious action. Moreover the position of the disease in the fifth nerve was, in many of the cases, uncertain. In some the symptoms may have been due to disease of the nucleus of the nerve, from which the gustatory fibres may be separate. Hermann suggests that more fibres may pass from the large and small superficial petrosal nerves, directly to the glosso-pharyngeal, than is commonly assumed; but the glosso-pharyngeal nerve has been paralysed without loss of taste in the anterior part of the tongue. It is highly probable that the difference of opinion regarding the course of the gustatory fibres is due to the circumstance that this path varies in different individuals.

Symptoms.—Loss of taste involves the perception of bitter, sweet, and saline characters, to which should, perhaps, be added the metallic quality. These may be lost in varying degrees. Each part of the tongue possesses the power of recognising every quality, but not in the same degree; bitterness and sweetness are appreciated chiefly by the glosso-pharyngeal at the back, acidity and saltness by the lingual in the fore part of the tongue, chiefly at the tip and edges. The onset of the defect may be sudden, as in hysteria; or gradual, as in most forms of nerve-lesion. In the latter it is usually unilateral; in rare cases both sides are involved. It is associated with other symptoms of loss of function of the affected nerves, as in the case mentioned, in which there was loss of sensibility in the face, and paralysis of the muscles of mastication.

Diagnosis.—Loss of taste has always to be carefully distinguished from loss of smell, since all flavours are recognised by the olfactory nerve, and it is commonly assumed that when these cease to be perceived, taste is lost. The power of tasting must be ascertained by powders or colourless solutions which shall convey no information. Citric acid, quinine, sugar, and salt, in powder or solution, answer well. The tongue must be held out, and the substance or solution placed on the part of the tongue it is desired to test, and after each observation the mouth must be rinsed with water. It must be remembered also that the anterior part of the tongue is almost destitute of the sense of taste, except on the edges and tip. If the loss is unilateral, the powder may be rubbed on the side of the protruded tongue, near the tip, with the finger, and the patient should indicate, by nodding or shaking the head, whether it is tasted, before the tongue is withdrawn into the mouth.

Prognosis.—This is good in hysteria, less favourable in nerve-affections. The loss due to affection of the facial nerve is frequently recovered from, but may prevail even when the function of the latter is recovered. In intracranial disease of nerves the prognosis is very unfavourable.

Treatment.—The treatment in nerve-disease is that of the cause of the symptom. Stimula-

tion of the nerves in the tongue may sometimes aid the recovery of function, and for this faradisation is the most effectual. In hysterical loss of taste this commonly suffices. Where it depends on affection of the mucous membrane of the tongue, local measures alone are necessary.

W. R. Gowers.

**TEETH, Diseases of.**—Synon.: Fr. *Maladies des Dents*; Ger. *Krankheiten der Zähne.*

Introduction.—The teeth are peculiar organs, both anatomically and physiologically. The three hard tissues of the teeth are comparatively of low organization, while they are in connection internally with a structure, the pulp, mainly composed of plexuses of nerves and blood-vessels, and their roots are covered externally with a highly nervous and vascular periosteum.

The *functions* of the teeth are important. They exercise a large influence in the production of articulate sounds. They have a keen tactile faculty, by which they recognise the texture of food, and detect the presence of foreign bodies. But their most important function is mastication, by which food is comminuted and at the same time insalivated, two essential preliminaries to digestion. The loss of the teeth is with many of the lower animals the limit of life, from the cessation of these processes; and the failure of mastication, through edentulous age, is a frequent cause of intractable dyspepsia in the human subject. This fact cannot be too constantly remembered by the practitioner. The restoration of mastication by means of artificial teeth is often the immediate cure of imperfect digestion, which diet and drugs have failed to influence.

The diseases of the teeth are for the most part of a surgical character, and need operative interference. The pathological conditions of the teeth are, however, of important interest to the medical practitioner, causing and explaining, as they do, many maladies, especially of the nervous system, and having a serious bearing on digestion and nutrition as dependent on efficient mastication.

Again, the forms of the teeth, and the characters of their tissues are, in some instances, indicative of former illness, and in other instances are of critical diagnostic value in establishing the existence of a constitutional taint which may modify or develop disease. The teeth are dermal organs, and, as such, are liable, especially during their development, to be affected by the poison of the eruptive fevers, leading to disastrous consequences to the teeth themselves, and to the immediately contiguous structures.

From the peculiar position and surroundings of the teeth, they are liable to mechanical injuries, and to chemical and physical changes of the most interesting nature in themselves, and in relation to the vital manifestations to which they lead.

In this article the diseases of the teeth will be discussed in the following order:—1. Abscess, and blood-stains; 2. Caries; 3. Enamel, pitted; 4. Eruption of wisdom teeth, difficult; 5. Hæmorrhage after extraction; 6. Loosening; 7. Necrosis, after acute diseases; 8. Nervous affections originating in diseases of the teeth. 9. Odontomes; 10. Syphilitic teeth; and 11. Tooth-ache.

1. **Abscess in dentine, and blood-stains.** Dentine is occasionally liable to abscess within its substance, from suppuration of enclosed fibro-vascular tissue. It is also not infrequently discoloured by the extravasation of hematine. In neither of these conditions do symptoms arise of interest to the practitioner.

2. **Caries.**—Caries of the teeth is by a great deal the most common pathological change to which the human body is liable. It generally affects some of the temporary teeth before they are shed; and there are very few adults, indeed, in whose teeth caries, in some degree, is not to be found. Dental caries is a softening and disintegration of the tooth's surface, gradually penetrating towards its centre. It is essentially a superficial affection, dependent on external influences. These are chiefly chemical, though partly mechanical, and it is not improbable that the action of a vegetable parasite (*Leptothrix buccalis*) has some share in the process. One of the most remarkable circumstances in this pathological change is, that though the dentine of the tooth undergoes, through disease, a radical change in physical characters and chemical composition, it long retains its vitality, and even becomes increasedly sensitive. The idea that death of the tissue antecedes caries is quite erroneous. The most obvious commencement of caries takes place on the surface of the dentine immediately underlying faulty enamel, but in some instances it commences in the enamel itself. When the enamel is attacked, it becomes opaque, whitish, or grey, and then gradually stained of a brownish colour, and this is soon followed by still more obvious changes in the dentine. The latter tissue undergoes more rapid alteration than the enamel; it becomes brown and soft, and the change penetrates in the direction of the tubes towards the pulp, while it spreads laterally beneath the as yet healthy enamel. These changes occur in endless variety, one form passing into another. The extreme varieties have been described as distinct species of decay, without, however, sufficient justification.

At times the disease advances to a certain stage, and then ceases; the intra-tubular material becomes calcified; and the surface perfectly hard and dull-brown or black. This is called 'arrested,' 'stationary,' or 'carbonised' decay. There is a peculiar and characteristic smell in dental caries, like that of gangrene of the lung, or like the scent of the little neuropterous insect *Chrysopa.* The softening of the dentine is brought about by the removal of the phosphate of lime in a soluble acid form, and its replacement by water. Carious dentine has an acid reaction.

The real causes of dental caries are as yet involved in much obscurity, and need not be here discussed. The consequences are of more practical import. Though carious dentine may retain its vitality for a considerable time, it ultimately dies, while part of the same tooth may be living, and a line of demarcation of the live and dead tissue indefinable. The results of caries are many and serious. Tooth-ache, neuralgia, periostitis, suppuration of the pulp, alveo-

lar abscess, and occasionally muscular paralysis, may all arise as a consequence of this condition; and it is particularly important for the practitioner to bear this in mind, as a possible association.

TREATMENT.—The treatment of caries may be divided into *preventive* and *remedial*. The general conditions of health that lead to caries are not known with sufficient accuracy to allow of such regulation of the functions of nutrition as would prevent the occurrence of decay when it arises from such causes, but the mechanical influences which occasion it are within easy control. Every mechanical action which injures the surface of the teeth should be guarded against, especially the crushing of the enamel by the pressure of contiguous teeth when crowded. Cleanliness, by brushing with a dentifrice—which removes all decomposing matter from contact with the teeth—is of the greatest importance; but tooth-powders should be soft, and free from cutting particles: vegetable charcoal being carefully avoided, as it contains small particles of silicates, which frequently remove the enamel. Remedial treatment cannot be called curative, as there is no restoration of lost tissue; and that which has become decalcified never hardens again. But caries may be arrested, and further decay prevented. The softened tissue should be removed; the hard subjacent structure polished and kept smooth; projecting edges, which might entangle food, levelled and burnished; and above all, cavities should be stopped, and, if possible, with gold.

3. **Enamel, rocky and pitted.**—It is of great importance to distinguish between syphilitic teeth, and other malformed teeth which have no similar signification. When Mr. Hutchinson first described the characters of teeth which are often associated with inherited syphilis, much unnecessary distress was occasioned by confounding teeth having rocky and pitted enamel with those that were truly syphilitic in their origin, and many persons supposed themselves to inherit syphilis, who merely possessed teeth bearing marks upon them which registered a temporary illness, or a condition of depressed nutrition in childhood when the affected teeth were forming. Teeth with rocky and pitted enamel vary indefinitely as to the extent of their defective formation, from a slight horizontal grooving in the enamel, to a condition in which the whole surface is rocky and rugged, and studded with pits like a thimble. In extreme cases the enamel may be almost entirely wanting; but there is no narrowing of the apices of the crowns of the teeth, and no crescentic notch in the superior incisors, as in syphilis. The defects of the enamel are nearly always horizontal in their disposition; and even the pits have such an arrangement in series. This condition is most frequently seen in the permanent teeth, though sometimes in the temporary. It is most manifest in the first molar, the incisors, and the canines. Rarely it affects the bicuspids, near the apices of the cusps; and still more rarely the whole bicuspid crown suffers. But it will be observed that the malformation is symmetrical in the corresponding teeth, and that in the different teeth it has occurred at a point in its development which each tooth had attained at one particular time. The writer believes that the mildest and severest cases are essentially the same in their pathological meaning, and that the difference is only one of degree. It has been supposed by Mr. Hutchinson that this condition of teeth is the result of the constitutional influence of mercury given in childhood. The writer believes it is quite unconnected with such supposed cause. It is extremely rare for mercury to affect the mouth in children. This condition of teeth occurs where mercury has never been given, and equally among peoples not addicted to the use of that drug. It is found, moreover, among extinct races, who lived before mercury was used as a medicine. The microscopical structure of teeth, thus degenerated, shows that the condition is essentially one of imperfect calcification of the enamel and dentine; and the writer believes that any influence or disease of childhood, suspending for a time or depressing the nutrition, may be an efficient cause. As this state of tooth is permanent, it remains a record through life of an illness in childhood. These defects in the tissues of the teeth are concurrent with their lamination. The tissues of the teeth, especially the dentine, exhibit a series of layers due to different degrees of calcification, in which the earthy impregnation has been greater and less alternately. This is a normal condition up to a certain degree; but when the laminæ of lesser calcification are extremely defective in earthy matter, histological defects arise which lead to the appearances in the teeth described.

4. **Eruption of wisdom teeth, difficult.**—Insufficient room in the jaw for the advent of the wisdom teeth is sometimes attended with very painful and even serious symptoms. These are confined to those cases in which the obstruction occurs in the lower jaw. The wisdom tooth has insufficient room to come through, and remains impacted at the base of the ascending ramus of the jaw, growing and pressing against the second molar. This gives rise to inflammation, and pain of a rheumatic character wandering down the neck and arm, the latter being often weakened in muscular power. In acute and neglected cases, abscess forms at the angle of the jaw, and burrows about the cheek. One remarkable symptom is trismus, which is very usual in these cases, and is a characteristic symptom; the masseter muscle becoming contracted and firmly set, so that the jaws can hardly be opened a quarter of an inch. This locking of the jaw sometimes occasions very unnecessary alarm.

Well-authenticated instances of epilepsy, delirium, and insanity have been recorded, having been occasioned by the resisted eruption of the lower wisdom teeth, and cured by removal of the cause of irritation.

TREATMENT.—The treatment depends much on the degree of obstruction. Lancing the gum is sometimes sufficient. Removal of the wisdom tooth is the proper cure. Where there is trismus it is necessary to wedge open the jaws—slowly but persistently; and then to extract the offending tooth, if possible. If it cannot be reached, the second molar should be extracted, when its posterior fang will sometimes be found absorbed. When once an abscess has formed in association

with an obstructed wisdom tooth, the removal of that tooth is unavoidable. Though it may be necessary to remove the second molar first, the third must afterwards follow, or the abscess will remain. The trismus immediately vanishes on the extraction of the tooth.

5. **Hæmorrhage after tooth-extraction.**—This is an occasional manifestation of the hæmorrhagic diathesis, but, considering how many teeth are extracted, it is rare. This form of bleeding usually comes on some hours after the tooth has been taken out, and consists of a more or less rapid welling up of blood in the recently emptied sockets. There is frequently a history of inherited hæmorrhagic diathesis. It is, moreover, occasionally associated with menstruation.

Treatment.—The treatment should be local and general. For the former the writer would recommend plugging the alveolar cavities with lint or cotton-wool, previously steeped in tincture of matico, red-gum, or turpentine; for the latter, the internal administration of turpentine, ergot, or tannin. Tourniquets have been devised for applying and sustaining pressure on the bleeding surfaces.

6. **Loosening of Teeth.**—Synon.: Spongy gums; False scurvy.

Description.—The term 'scurvy of the gums' has long and generally, though very incorrectly, been applied by dentists to this condition of the gums. Instead, however, of being an enlargement of the gums from extravasation of blood within them, it mainly consists of a general dilatation of the smaller vessels of the papillæ and periosteum, and ultimately of those of the alveolar bone. At first the gums are enlarged and protrude; but afterwards, while the edges still remain thickened, they recede from the necks of the teeth, which consequently appear elongated. As the gums retire so do the alveolar processes, which at the same time become large and open, and like the periosteum are soft and spongy. This, as a consequence, loosens the teeth; which, especially in the front upper jaw, have a tendency to protrude. The disease usually occurs about or after middle life. In this condition the gums are very liable to bleed from the slightest friction; tartar forms around the necks of the teeth; considerable ooze from beneath the edge of the gum, often of a purulent character, is discharged; and the breath is generally offensive.

Ætiology.—The causes of this condition are neither constant nor always intelligible. Crowding of the teeth, dyspepsia, frequent pregnancies, mercurial action at some previous time of life, and continued use of iodide of potassium, have all appeared to be causes of this spurious scurvy. But very often no apparent reason can be assigned for its occurrence.

Treatment.—Restoration of the general health and extreme cleanliness of the mouth are essential. All tartar should be removed, and the bleeding attending this operation often has a salutary effect. A fairly stiff toothbrush should be used unsparingly, and the bleeding of the gums on such occasions is beneficial. This should be followed by an astringent mouth-wash, such as a solution of alum in a decoction of cinchona.

7. **Necrosis of the jaw and teeth after the eruptive fevers.**—These are among the secondary maladies which are apt to occur after small-pox, scarlet fever, and measles in children. The cases are all singularly alike; they usually occur between the third and eighth years, and the severity of the previous attack of fever is immaterial. The local symptoms, which usually appear from three to six weeks after, consist in a peeling off of the gum around one or more of the temporary teeth; and this continues until the bare jaw is exposed to a depth which corresponds, not only to the fangs of the temporary teeth, but the bony capsules of their immature successors. Transverse ulceration then usually follows; and the temporary teeth, their alveoli, the immature permanent teeth, and their bony capsules are shed. Frequently this occurs on both sides of the mouth symmetrically. There is no swelling or formation of supplemental bone. In the lower jaw the writer has never seen the base of the bone involved, and the consequent disfigurement is singularly slight. These exfoliations occur much more frequently after scarlet-fever than after measles, and they are rare after small-pox.

Treatment.—The treatment of these cases should consist in as little interference as possible. Little need be done, beyond attention to cleanliness and deodorisation, and the removal of the sequestra when quite loose.

8. **Nervous system, affections of, dependent on diseases of the teeth.**—Affections of the nervous system dependent on the teeth, but not arising from the processes of dentition, have not been sufficiently recognised, and records of them are so few and partial that it is difficult to generalise upon them. These affections are either *reflex*, *direct*, or *complex*. In the first case some portion of the nervous system receives an exaltation of function from the irritation of a tooth-nerve; in the second case some contiguous nerves are involved by the spread of inflammation from diseased teeth, or the pressure of the inflammatory products; and in the third case both would be entailed in a mixed and uncertain proportion.

*Reflex affections.*—As regards the reflex phenomena of disease dependent on the teeth we may enumerate pain, muscular spasm, muscular paralysis, paralysis of some of the nerves of special sense, and perverted nutrition. These reflex phenomena have been found to be induced by the following diseases:—caries, with or without exposure of the pulp; exostosis—hypertrophy of the crusta petrosa; nodular developments of dentine in the pulp-cavity; periostitis, plastic or suppurative; impaction of permanent teeth in the maxillary bones; and crowding of teeth from insufficient room.

Small excrescences of dentine occurring within the pulp-cavity, or in the form of small nodules in the substance of the pulp, are apt to produce erratic and wide-spread pain among the dental nerves of one side of the face. The same condition not infrequently occurs where the morbid change consists of fine nodular exostoses on the fangs of the teeth. In these cases the pain is reflected from the spot of irritation over a large nervous area; but the tooth containing the offend-

ing growth is usually perceptible by tenderness or elongation, or a consciousness on the part of the patient that it is the centre of offence. Where it arises from an exostosis it is apt to be repeated with several teeth one after another. These cases are by no means uncommon, and are often made the subjects of unavailing medical treatment for a long time. Tooth-extraction is the only remedy.

Wry-neck, epilepsy, and tetanus are three forms of muscular spasm which have been distinctly traced to the irritation of disease of the teeth in the adult.

Among the nerves of special sense which have been affected by reflex nervous action from tooth-irritation are the auditory and the optic; cases of deafness and of complete amaurosis having arisen from these causes.

There is a not infrequent form of muscular and sentient paralysis, affecting one or other of the arms, which has often been wrongly diagnosed, and led to much needless suffering and alarm. It consists of weakness, some pain, and occasionally loss of feeling in the arm and hand in question. Pain frequently commences in the side of the neck or at the point of the shoulder, and is of an aching, weary character, much increased by any muscular effort of the limb, which usually hangs in a powerless, listless attitude by the patient's side. The hand is feeble, and the patient has difficulty in grasping and shaking hands with cordial pressure. These symptoms are sometimes only induced by exertion. Such cases have been several times supposed to depend on central nervous disease, and have been so treated. They may depend, however, on some irritation of a tooth of the lower jaw, usually a back molar, which is transmitted through the cervical and brachial plexuses of nerves. A carious or impacted wisdom-tooth is usually the offender. Extraction of the tooth is followed by complete relief within a few hours. There are also on record some curious cases of perverted nutrition, in which the colour of the iris has been altered, and the hair at certain spots has become abruptly white, ulcers have formed and refused to heal, in the neighbourhood of the neck and cheeks, all dependent upon tooth-irritation.

*Direct affections.*—Direct affections of the nervous system, caused by tooth-disease, are far less common and less varied than those which are reflex, and their mode of production is more obvious and intelligible. The portio dura of the seventh nerve, the nerves which enter the orbit, and, very rarely, the dental nerves in their tracts in the jaw, are those only which suffer in this way—are entangled, that is, in their course by those inflammatory influences and products which tooth-diseases engender.

The consequences of the direct implication of nervous trunks by the inflammatory results of tooth-disease are so very grave, especially when affecting the nerves of the eye in their course to the orbit, and the ultimate results so permanently serious, when relief is not speedily given, that it is impossible to exaggerate the importance of these cases. The writer would lay the more stress upon this subject, because he fears that such cases have been misunderstood, and that injuries have thus become permanent and irremediable, which, if correctly interpreted and properly treated at first, would have been easily removed.

The entanglement of the portio dura leading to facial palsy has arisen from the plastic exudation around an upper back molar, and has been immediately cured by the extraction of the tooth. There have been several examples in which the nerves passing into the orbit, and probably within the orbit, have been surrounded with plastic exudation, leading to the destruction of their functions, and to temporary or permanent loss of sight. The author has seen several such cases; some were, and all might have been, completely cured by the early removal of the offending teeth. It is very rare indeed for the dental nerves in their passage through the jaw-bones to be pressed upon and functionally disturbed by the inflammatory products of carious teeth. But such cases have occurred, producing loss of sensation of the front teeth, lips, and chin.

*Complex affections.*—In some instances the nervous symptoms are clearly of a mixed character, partly reflex and partly direct. This is no doubt the case in those remarkable and not infrequent examples of trismus, in which the jaws are firmly closed by the spasmodic action of the masseter muscle, on the side where a carious or impacted lower molar tooth is keeping up irritation, and which is immediately cured by the extraction of the tooth.

The same may be said of those wide-spread and diffused pains, attended with extreme tegumentary sensibility, which so often accompany ordinary toothache.

9. **Odontomes, or tooth-tumours.** — The teeth occasionally develop tumours of their hard tissues of an interesting and remarkable character. They are divisible into two distinct groups —those which are *congenital*; and those which are developed in after-life, the *secondary* or *induced*. The former consist of (*a*) 'warty' growths of the crowns of the teeth; (*b*) 'hernia' of the fangs; and (*c*) nodules of enamel on the roots of the teeth. But with none of these is the practitioner likely to be concerned, as they are not known to produce symptoms other than those which suggest surgical interference.

The secondary or induced odontomes are (*a*) 'exostosis' on the fangs; and (*b*) 'dentine excrescence' within the pulp-cavity of the tooth. These forms of tooth-tumour, though smaller and less obvious than the others, are both liable to occasion symptoms, painful and obscure, which it may be difficult to diagnose and treat.

*Exostosis* of the fang of a tooth consists of an increased growth of the normal outer layer of the fang—the tooth-bone. This occurs in very varying degrees and forms, and, as a pathological condition is not uncommon. But it is unusual for these hypertrophies to give rise to symptoms of disease. They do so, however, sometimes and with great severity, the one symptom being *pain*, and this is especially the case when the exostosis is small, nodular, and forming on one side of the fang. These exostoses are apt to attack the teeth in succession, and they occur either in early or middle life. Such cases usually commence with pain in some particular tooth, which

is apparently sound; the pain is inconstant, of a neuralgic character, and wandering about the side of the face and head. The affected tooth is often elongated, tender, and very susceptible to changes of temperature. The pain is not constant, but intermitting; increasing, however, in frequency and severity; and, though wandering over a considerable area, always emanating from the one affected tooth. The pain at length becomes intolerable, and the apparently sound tooth is extracted, displaying at its fang-end a small lobulated exostosis. The loss of the tooth is followed by complete relief, and this may be permanent; but not infrequently, after an interval of entire ease, another tooth, generally an immediate neighbour, is attacked in the same way, and goes through the same process, till it is extracted. And this may occur till all the teeth are lost. No treatment short of extraction appears to palliate the symptoms.

*Dentine excrescences* in the pulp-cavity may exist without causing any symptoms; or they may be associated with pain, and a general history scarcely to be distinguished from exostosis. In some of the cases, however—especially where there is a general intrinsic calcification of the pulp, the symptoms have assumed the aspect of the severest tic-douloureux. Extraction is the only remedy.

10. **Syphilitic teeth.**—We are indebted to Mr. Hutchinson for the interesting discovery that children who inherit syphilis are liable to characteristic deformity of certain teeth, and that this is not infrequently associated with specific interstitial inflammation of the cornea. Syphilitic teeth are small, narrow, more or less pointed, and usually of a dirty grey colour. Both the temporary and permanent sets may be affected; but it is the front teeth of the latter that exhibit the characteristic and most marked deformity. The lower incisors are peggy and pointed; those of the upper jaw are narrowed, instead of expanded towards the cutting edge; and the centrals frequently have a crescentic notch. The other irregularities of shape in the teeth may arise or be closely imitated, where there is no specific taint, but the crescentic notch in the contracted cutting edge of the superior permanent central incisor is believed to be absolutely diagnostic of inherited syphilis. As such, it is of great value to the physician in deciding on the nature of doubtful symptoms which may, or may not, have an hereditary syphilitic origin. Mr. Hutchinson considers that these malformations of teeth are occasioned by specific stomatitis. But perverted form and nutrition need not be inflammatory; and the writer doubts if such action arises in these cases. The teeth are dermal organs, and upon the skin syphilis inflicts some of its chief injuries, which need not be inflammatory.

11. **Toothache.**— The term toothache can scarcely be used with critical accuracy, as it is popularly applied to any pain in or immediately round a tooth, without distinction as to its cause or character. Such pain may be produced by many conditions, the commonest of which is *dental* caries, with or without exposure of the pulp. But other influences may induce pain, scarcely to be distinguished from that of tooth-decay. Among these causes may be enumerated *impaction of the wisdom-teeth*, especially the lower; *inflammation of the tooth-pulp* and *periosteum; rheumatism; deposit of secondary dentine* in the pulp-chamber; and *exostosis.*

Excepting where pain is very severe, and of such a character as to assert its exact locality, it is not infrequently referred to a position, and often to a particular tooth, other than the one affected. Where this is the case, this pain is, the writer believes, always anterior to the locality of its origin; and it is often only by roughly manipulating or sharply tapping the teeth that the actual offender is discovered.

Toothache dependent upon *dental caries* usually arises when the decay approaches the tooth-pulp, and is the result of its inflammation. The tooth-pulp consists very largely of nerves, and is closely boxed up within unyielding walls, so that its swelling gives rise to great internal pressure; hence the pain is of a very severe and distressing character. Inflammation frequently yields to complete or partial suppuration of the pulp; the escape of the matter being attended with marked relief. This may arise either from the breaking down of the external carious wall of the tooth, or from its finding vent through the orifice at the apex of its fang, and so constituting an alveolar abscess, which ultimately bursts, either as a gumboil within the mouth, or by a fistulous opening upon the cheek.

The *impaction of a wisdom-tooth* produces a form of toothache which is usually of a dull character, and gives a sense of tension and restraint. It arises from a want of room for the coming tooth, whose growth produces pressure on the contiguous structures. The pain often wanders along the whole jaw, and may appear to be especially associated with any other tooth on that side. Occasionally the second molar becomes so eroded, through absorption of its posterior fang by the pressure of the wisdom-tooth, as to cause inflammation of its pulp, in which case there may be acute toothache and loosening of the tooth.

*Inflammation of the tooth-pulp* may sometimes occur spontaneously, and thus give rise to pain.

*Inflammation of the periosteum* around any particular tooth, the result of disease or any external violence, may have the same effect. It is said also that the inflammation of the fibrous tissues round the teeth may be of a rheumatic character, but of this the writer has no positive evidence. It may, however, arise from syphilitic periostitis, and from the administration of mercury when pushed to approaching salivation. Iodide of potassium has sometimes a like effect.

*Secondary dentine* and *exostosis* may also be associated with toothache, which is frequently of a neuralgic and wandering character, so that it is often difficult to fix upon the offending tooth. Whether the pain results from the pressure of the adventitious growth, or whether they are both the result of some sub-inflammatory condition, it is difficult to say.

Treatment.—The treatment of toothache consists in attendance to the general health; in local applications; and in extraction of the offending organ. Tonics, especially quinine, are often useful where the pains are of an inconstant and

neuralgic character. Food and stimulants, especially wine, would also give relief in such cases, where the patient is below par. When the toothache arises from caries, great relief is experienced in the early stages by the application of creasote, carbolic acid, and other hydro-carbons. Where pus is pent up within the pulp-cavity it should be evacuated, either by opening the pulp-cavity from above, or by drilling the tooth.

Where the pain arises from impaction of wisdom-teeth, relief from pressure must be given by extraction. If the wisdom-tooth cannot itself be got at, the second molar should be taken out. In all cases where the pain has become excessive and intractable, removal of the tooth is the only remedy. JAMES SALTER.

**TEETH, Grinding of.**—Automatic movements of the mouth are common to many diseases, especially in young subjects. In cerebral disorders in children we often notice a vertical movement of the jaw, as if the patient were chewing. At other times the movement is a lateral one, and the teeth are ground together, so as to give rise to a hard unpleasant grating sound. This symptom is not, however, necessarily dependent upon disease of the brain, nor is it peculiar to early life. Grinding of the teeth may be observed at all ages, and in many different complaints. It is frequently spoken of as a symptom of worms, and is, indeed, often present when the alimentary canal is infested with these parasites; but the symptom is in such cases quite independent of the worms, and is to be ascribed merely to the intestinal derangement which is the essence of the disease, the presence of worms being merely an accidental complication. Disordered bowels are by far the most common cause of grinding of the teeth, and therefore, with the exception of cerebral disease, this symptom is almost confined to such disorders as are accompanied by derangements of the alimentary canal. Thus children with tuberculosis often grate their teeth together with painful persistency; but in this disease an acid condition of the contents of the stomach and bowels is an almost invariable complication. Again, in rheumatism and gout, where there is the same tendency to acid fermentation of food, grinding of the teeth is a common symptom in the adult.

The movement of the jaw occurs, as a rule, independently of the will, and is seldom noticed except during sleep. Sometimes, however, children will grind their teeth voluntarily, and apparently with full consciousness of what they are doing. Such cases are, however, rare.

The *treatment* of teeth-grinding consists in the correction or removal, if possible, of the condition upon which it depends.

EUSTACE SMITH.

**TEETHING, Disorders of.** *See* DENTITION, Disorders of.

**TELANGEIECTASIS** (τῆλε, far, ἀγγεῖον, a blood-vessel, and ἔκτασις, a dilatation).—Aneurism by anastomosis. *See* ANEURISM; and TUMOURS.

**TEMPERAMENT.**—SYNON.: Fr. *Tempérament*; Ger. *Körperanlage*.—This term denotes the correlation of grouped differences existing among men, in respect of physical structure and conformation, with differences of functional activity, of mental endowment and disposition, and of affection by external circumstances.

The early writers on medicine, recognising the facts that each individual man is different from all other men in physical appearance; that, again, in every man are found qualities proper to himself, inherent and indestructible; that, again, on a review of many men a constant association of certain qualities with certain variations in physical appearance may be observed, proceeded to make generalisations, tending to the doctrine of temperaments. This doctrine, as fully set forth by Galen, established nine kinds of temperament. First, the *balanced* temperament (εὐκρασία, *temperies*) consisting in a mixture of different qualities in such due proportion that none is in excess. Next, four temperaments of simple excess or default—the *hot*, the *cold*, the *moist*, and the *dry*; and then four mixtures of these—the *hot and dry*, the *hot and moist*, the *cold and dry*, the *cold and moist*. Subsequently, under the influence of the humoral pathology, temperaments were classified as *sanguineous*, *bilious*, *phlegmatic*, or *melancholic*, according as the heart, the liver, the head, or the spleen were supposed to be predominant in modifying the humours of the body. More recent writers have again abridged the list, and have given its categories a new interpretation. They mostly acknowledge but three temperaments—the *sanguine*, the *nervous*, and the *lymphatic*. The balanced temperament is not included, because no individual of such perfect structure exists. But it is equally true that the descriptions by which the other terms are defined represent either individuals used as types, and therefore correspond fully only to one or very few of the units of large genera, or are constructive types corresponding to no single existence.

Regarding the method of classification as wholly artificial, yet without denying its usefulness, we propose to preface the generally accepted description of the three temperaments above mentioned by a brief analysis of Galen's picture of the εὐκρᾶτος. The thoroughly tempered human being is in his bodily constitution exactly midway between slimness and stoutness, between softness and hardness, between hot and cold. In his mental constitution he exhibits the exact mean between rashness and timidity, between sluggishness and precipitancy, between the sweetness of pity and the bitterness of hatred. Such an one is brave, affectionate at home, and abroad discreet. To these essentials are added, of necessity, temperance in eating and drinking, perfect digestion and assimilation of food, physical and psychical energies without a flaw, the best powers of feeling, the best powers of movement, a clear skin, a good breath. He is neither too much given to sleep nor too wakeful, is midway between baldness and hairiness, between darkness and fairness of complexion. When a child he has reddish rather than black hair, in adult life the reverse. The three modern categories correspond fairly to Galen's mixed temperaments; the sanguine to the hot and moist, the nervous to the hot and dry, the lymphatic to the mixtures of cold with moist or dry.

**The Sanguine Temperament.**—Persons belonging to this group are described as being ruddy and bright of complexion, as having strong and salient muscles, a relatively large chest, and a relatively small head. The play of their senses, the determinations of their will, the responses of their muscles to impulses, are energetic and well-directed. Arterial blood abounds in them; their veins are small. The functions of their bodies are rapidly and easily performed. The functions of their minds show a similar vivacity. Rapid thought, quick imagination, brilliant courage, are associated with want of depth and persistence, with elastic forgetfulness even of strong impressions. In illness such people inflame quickly, develop diseases in a complete and regular way, and defervesce quickly, often with well-marked crisis. They are especially liable to gout, acute inflammations, and active hæmorrhages. They are men who dominate their fellows.

**The Nervous Temperament.**—Herein, as authors tell us, the skin is dark, dull, earthy, or sallow, and is hot and pungent to the touch, instead of being warm and moist. The cranium is large in proportion to the face; the muscles spare and not well-defined; the chest narrow; the circulation languid, with preponderance of the venous system. The face has the lineaments of energy and intensity of thought and feeling; the movements are hasty, abrupt, often violent, in alternation with languor. The affections are violent and persistent, the sexual passions usually very strong. Sensations are intense, far in excess of exciting causes. The mental powers are large and capable of persistent exercise. The bodily organization favours venous congestion and hæmorrhage, neuralgia, hepatic and intestinal obstructions, and the mental lunacies. Nevertheless, these people are often found to endure long fatigue, privation, and exposure better than the sanguine. They are the people who teach or lead their fellows.

**The Lymphatic Temperament.**—A heavy ill-proportioned ungainly form of body, large joints, bulky head, large hands, broad flat feet, light or reddish hair, a sallow or pasty complexion, accompany a general slowness and languor of bodily function. The muscles are often large, but their movements are awkward or inaccurately directed; the chest and heart are inadequate in bulk to the rest of the body. With this, there may often be combined much mental firmness, solidity, and constancy—a good judgment if a poor energy. The power of resistance to acute disease is inferior; the tendency to chronic diseases, particularly of strumous and asthenic kinds, is pronounced.

In the sanguine temperament a predominance of blood-making power and of muscular development is asserted. It may, perhaps, be spoken of as the temperament in which the spinal system and the parts directly subordinate thereto are most developed. In the nervous temperament the predominance of the cerebrum is clearly indicated. In the lymphatic temperament, languor or slowness of both nervous and circulatory systems is connected with slowness or default of the general nutrition.

Practically these types comprehend only a part of mankind. If we admit that they can be extended in their application by the recognition of mixtures of them among themselves in various proportions and degrees, we must admit also that there exist, outside of them altogether, numerous correlations of much importance to the physician. Moreover, many of the constituents of temperaments are capable of being changed by age, external circumstances, and habit. New combinations may be introduced by these agencies, or by bodily changes arising in accident or disease. The building anew of a man's temperament by religious enthusiasm, by suffering, by moral control, or by indulgence, is a spectacle daily to be seen and studied. In that analysis of the κρᾶσις of the individual which must furnish the interpretation of much of his behaviour in illness, the accurate estimation of many combined influences, native and accessory, has been called the stumbling-block of practice. It may better be called the touchstone of practical skill. That physician does well who carries with him a mental picture of some such perfect human animal as Galen has imagined; and who marks on the diagram, with his patient before him, the lines of original shortcoming, of development, of warp, of injury, of degeneration, so as to arrive at some clear sight of the outcome or resultant of all in the present organisation and reactions of that patient.

WILLIAM M. ORD.

**TEMPERATURE.**—SYNON.: Fr. *Température*; Ger. *Körperwärme*; *Eigenwärme*.

INTRODUCTION.—The human body, like that of all warm-blooded animals, has a heat of its own, which is, to a great extent, independent of the surrounding temperature. As long as the body is in a state of health, the external circumstances must either very materially change, or a change of them must operate for some length of time, before any but a transitory elevation or depression of the blood-heat will occur. But the temperature becomes much more easily altered when the functions of the body are abnormally performed, in consequence of disease. A change of the blood-heat is often the very first symptom of a disease, and it may occur even before the slightest indisposition is felt by the patient. Hence observations of the temperature may be extremely valuable for diagnosis, and the course of most diseases being accompanied by corresponding alterations of temperature, which in many diseases are quite typical, the great importance of closely watching the course of the temperature becomes evident. Clinical medicine has by the use of thermometry entered on a new phase, having gained the means of a numerical expression for variations of complex states of the system which the practitioner, from the indications of the thermometer, may detect earlier and judge of more correctly than by any other symptom. For an exhaustive account of the changes of temperature which may be observed in health, and especially in disease, the reader may be referred to the classical work of Wunderlich, translated for the New Sydenham Society.

SOURCES AND REGULATION OF THE BODY-HEAT.—The sources of animal heat must be chiefly sought for in chemical processes, especially oxidation, which are constantly going on in

the blood and tissues. To a minor degree various processes of a purely physical nature, such as friction, or the transformation into heat of other forms of energy, themselves the outcome of chemical processes, have also a share in its production. But this generation of heat within the body does not explain the fact of the blood-heat being constantly kept at the same level. This fact presupposes that the amount of heat produced is exactly equalled by the sum-total of the losses of heat which are constantly going on—at the surface of the body, by radiation and evaporation, from the lungs by evaporation and by the warming of the colder air taken in at every inspiration, in muscles when mechanical work is done, in the intestinal canal by the warming of ingested cold food or drink, and, lastly, by the dejecta which leave the body. Any disturbance of this equilibrium must be followed either by an increase or by a lowering of the general temperature. But there is another factor, without which the maintenance of this equilibrium, and an equal distribution of the heat throughout the body, would be impossible, namely, the circulation of the blood. By this means a regulation of the loss of heat may be effected whenever required, the blood-supply to the skin varying as the arteries dilate or contract under the influence of the vaso-motor nerves. But not only the losses of heat may be varied, but its production also is capable of being modified, under the influence of the nervous system. Whenever the external temperature would cause too considerable a loss of heat, the peripheral arteries contract, and the circulation becomes slower; heat is thereby retained in the body, but at the same time the heat-producing processes are stimulated to increased action, as shown by the quantity of carbonic acid given off being increased. When, on the contrary, the loss of heat on the surface is prevented, the peripheral arteries dilate; the heart's action becomes accelerated; and a much greater quantity of blood flows through the skin and peripheral parts, the sweat-glands pouring forth an increased quantity of sweat, which, by its evaporation, tends considerably to lower the temperature. At the same time the respiration also is accelerated. Less blood flowing through the internal organs, the chemical changes in them, and therewith the heat-production, become less active, and are further diminished by a direct influence of the nervous system on these processes. Thus a most wonderfully precise reflex-mechanism regulates the heat of the body, by altering the production as well as the loss according to necessity, the maintenance of the proper heat being in this way doubly secured.

Temperature in Health.—The heat of the blood is at every moment of life the result of different forces balancing each other, namely the heat-producing and the heat-destroying processes and influences. So also the temperature of a single part of the body results from the heat-production going on within it, and its exposure to cooling influences, and is chiefly dependent upon its blood-supply. The heat of the body is, therefore, most variable on the surface, and is lowest in its uncovered parts, especially in the most projecting ones; almost uniform, on the contrary, in the interior where only slight differences, amounting to a few tenths of a degree, exist. In the lower animals Claude Bernard found the temperature highest in the hepatic veins and the right auricle. The heat of an organ increases when its functional activity is heightened, as, for instance, when the brain, a muscle, or a gland is stimulated to increased function.

It is necessary, for practical purposes, to consider chiefly the temperature in the interior, or the blood-heat. The blood-heat is measured, as nearly as possible, by the clinical thermometer. *See* Thermometer, Clinical.

In healthy men the temperature of the body, as measured in the axilla, is about 98·6° Fahr. (37·0° C.) Inside the mouth, underneath the tongue, it is almost the same; whereas in the vagina or rectum it is 0·3° to 0·6° higher. Under special circumstances—for instance, when a considerable cooling of the surface takes place, or when the skin freely perspires—the difference may be somewhat greater, and there may be a difference of 20° between the temperature of exposed parts of the skin and the interior; on the other hand, all parts may be pretty equally warm in the morning in bed, or in a warm room, or when the circulation has been influenced by slight exercise, or by a good meal and a moderate amount of alcohol. Of considerable influence upon the temperature of the surface of the body is the amount of fat in the subcutaneous tissue. In plump children and in very obese adults the surface may be considerably colder than the interior, and in the latter case there generally is yet another and even more effective cause for this difference, namely, weakness of the heart's action.

The temperature of the body is not the same all through the day. Numerous careful observations, of which those of Jürgensen, Liebermeister, and Ogle, may be specially mentioned, have shown that even when kept entirely at rest in bed, the temperature of a healthy person will fluctuate from about 1·8° to 2·3° Fahr. in the course of the twenty-four hours; the mercury standing lowest between 2 A.M. and 6 A.M., and then gradually rising until it reaches the highest point between 5 P.M. and 8 P.M. This rise is mostly not continuous, but becomes somewhat slower, or even interrupted by a slight decrease, in the middle of the day, the afternoon hours showing a more rapid elevation.

This daily fluctuation of the body-heat is a fact of fundamental importance, for it not only takes place in health, but also when, in disease, the whole range of the temperature is either depressed or abnormally elevated. The causes of this daily fluctuation of temperature are not yet fully made out; but this much is certain, that rest and movement, as well as the taking of food, have some share in producing it. Another cause which must not be overlooked, and which was pointed out by Liebermeister, is the force of habit and inheritance.

Race and sex have no influence, to speak of, upon the range of the temperature. Age, on the contrary, has, by different observers, been found to influence the range as well as the daily fluctuation. In the infant, immediately after its birth, the temperature is slightly higher than later on, its temperature in the rectum having

even been found higher than that of the vagina of its mother. A higher range is maintained in the first weeks of life, and there has also been found wanting in infants that steady course of the daily fluctuation which is observed in adults. In children, even somewhat more advanced in age, the temperature is still easily influenced by external changes, and the range of the daily fluctuation is greater. In old age again, the range is a little higher than in adult life, and here, also, a greater mobility of the temperature under various external causes is observed. No appreciable influence on the temperature in association with menstruation or pregnancy can be observed in healthy women. Parturition slightly increases the temperature, evidently by the increased muscular action, an increase which is compensated by a corresponding fall after the birth of the child. If no complications occur, the temperature in the puerperal state generally does not deviate from the normal.

Such, in fact, is the constancy of the body-heat in health, that the general conditions of life, occupation, &c., hardly show any influence upon it, and whenever, by muscular exertion, or by the effect of external heat or cold—as, for instance, by baths of various temperatures—a more considerable deviation from the normal range has for a time been caused, there is a strong tendency in the system to compensate the increase or the loss of heat, by a corresponding fall or rise afterwards. This faculty is somewhat altered in disease; and even in those states which are on the borderland of disease, we frequently find a less perfect action of the regulation of the local or general temperature of the body.

Local Changes of Temperature.—Local changes of temperature are brought about by external thermic influences acting locally, or by disease. Local stoppage of the blood-supply or local death lowers the temperature of the part; inflammation, in its first stage, raises it. Considerable local changes of temperature may arise simply from vaso-motor disturbances. Thus in a paralysed limb the temperature may either be lower or higher than in the corresponding limb of the other side; in hemiplegia the temperature of the paralysed side is frequently found ½–1½ of a degree higher than on the normal side. Neuralgia is sometimes accompanied by dilatation of the blood-vessels, and a considerable rise of the local temperature; and, as a purely vaso-motor disturbance, local heat and redness of the skin, due to a passing dilatation of blood-vessels, sometimes occur in hysterical females.

Changes of the General Temperature.—Of much greater practical importance than local disturbances of the body-heat are changes of the general temperature, such as occur in many diseases, whether of the nature of *depression* or *elevation*.

1. **Depression.**—Depression of the general temperature is observed as a consequence of considerable loss of blood; in starvation from any cause; and in the wasting of some chronic diseases, such as cancer of various organs, or in diseases of the brain and spinal cord. In brain-disease, with the symptoms of melancholia, extreme coldness of the surface and lowering of the general temperature sometimes occur. Vaso-motor paralysis and dilatation of the blood-vessels are sometimes the cause of extreme loss of heat in severe injuries to the upper part of the spine. In a very rapid manner a considerable fall of temperature may take place in the collapse sometimes occurring in the course of typhoid fever, but especially in that of acute peritonitis, and of poisoning by various substances. In the collapse of cholera the lowering of the temperature of the axilla may be considerable—a temperature as low as 89·6° Fahr. (32° C.) in the axilla, and even less under the tongue, having been observed; but the temperature of the interior of the body is generally very high, reaching 104° Fahr. (40° C.), and sometimes much more. In peritonitis a low general temperature may be present for days, even if the peritonitis supervene in the course of typhoid fever. With the collapse caused by alcoholic intoxication great depression of the general temperature occurs, when the patient is exposed to cold and wet; and in a case of carbolic acid poisoning, which came under the observation of the writer, the temperature fell as low as 93·92° Fahr. (34·4° C.). A temperature of 71·6° (22° C.) has been observed in sclerema neonatorum.

In chronic diseases of the respiratory organs, not of an inflammatory or tuberculous nature, as well as in chronic heart-disease, the temperature is generally found somewhat below normal; and the same is the case in chronic nephritis, more especially in those cases accompanied by general dropsy. In cases of the latter kind we even sometimes see a febrile temperature, caused, for instance, by tubercular disease of the lungs, become considerably abated, if not entirely reversed, when chronic kidney-disease supervenes; as also when intestinal ulceration becomes more prominent, or leads to peritonitis.

2. **Elevation.**—Elevation of the general temperature, as part of the febrile process, is the most prominent symptom in most diseases of an infectious origin, as well as in diseases of an inflammatory nature. In both an increased production of heat, no less than a disturbance of the regulation of the temperature, is the effect of the presence in the blood of some foreign substance, acting injuriously on the nervous system, and causing altered chemical processes. Modern theories give a more and more prominent part in these actions to organised bodies (fungi, bacteria), which, in themselves or, possibly, by products of their own life-changes, or by the changes which they cause in the fluids of the body, are assumed to be the cause of the febrile process, and thus of the increased temperature.

The proper balance of the heat-forming and heat-destroying processes may also be disturbed by other influences acting upon, and by primary diseases of, the nervous system. When the body is subjected to external cold, after it has been fatigued by exercise, and already cooled by perspiration—if, for instance, a cold bath were taken under such circumstances, a rigor, with rapid rising of the temperature may follow; but, no local disease becoming developed, the temperature quickly goes down again amid profuse perspiration, and the whole attack may be

over. Or a disturbance of the heat-regulating functions of the nervous system may be caused by the irritation of some nerve-filaments, as by a gall-stone passing the biliary duct, or a stone passing the ureter or the urethra, and a febrile attack will follow. The rigor, leading to a high fever of an evanescent character, which may follow the introduction of a catheter (urethral fever), sometimes belongs to the same group of cases. But generally, in cases of this last kind, the nervous system is already in an abnormal state through the previous disease of the kidneys or bladder. The functions of the nervous system may further be deranged by injury; and a rise of temperature has not only been observed in injuries to the brain, but, in a most excessive degree, sometimes after injury of the cervical part of the spinal cord, when temperatures of 110° to 111° Fahr. (43·3° to 44° C.) have been observed (B. Brodie, H. Weber, Teale, and others). In tetanus a very high temperature may occur, rising still higher a little after death; as much as 112·55° Fahr. (44·75° C.) was reached in a case observed by Wunderlich. An alteration of the heat-regulating functions of the nervous system may be brought about by a considerable external heat acting upon the body, especially when combined with moisture of the air. In cases of sun- or heat-stroke, it is quite common to see the temperature of the body rise to 108° Fahr. (42·2° C.) and more; and it would seem probable that a febrile elevation of temperature, if going on unchecked for a considerable time, by causing exhaustion of the nervous system, may lead to hyperpyrexia. Thus it is not very uncommon to see the temperature rise excessively in infectious diseases, especially scarlatina, towards the close of life (proagonic hyperpyrexia); and the temperature may, in such cases, even rise a little more immediately after death. This is due to the losses of heat being greatly reduced after the stoppage of the circulation, the heat-production going on in the interior for a time; and the gradual failure of the circulation probably also takes a great share among the causes of a proagonic hyperpyrexia.

Hyperpyrexia sometimes comes on in the convalescence from acute rheumatism, even after the fever has entirely subsided, and when the patient is on the point of being discharged from the hospital. An excessive rise has occurred and caused death in severe cases of hysteria; and in hysterical patients hyperpyrexia has occasionally been observed without any of the other symptoms which in other cases usually accompany so grave a phenomenon. Cases of this kind are extremely suspicious, and in some of them it was discovered how this hyperpyrexia was simulated. Thus the patient has driven up the mercury by rubbing the bulb of the thermometer between the folds of her night-dress; whilst in other cases the high elevation of the mercury has been brought about by means of poultices, or by the patient having lowered the top of the instrument, so that the column of mercury began moving by its own weight. This, however, is not possible with a thermometer of the thin bore which English thermometers now generally have. A very high temperature, to which the pulse and respiration and the other symptoms do not correspond, must always arouse a suspicion that the rise of the mercury has been artificially produced, and the verification will be easy if the physician carefully watch the mercury as it rises, or by taking the temperature in the rectum or vagina.

The very important part which the nervous system plays in regulating the blood-heat, is also seen in the great liability of the temperature easily to deviate from the normal range during convalescence from acute disease, when the weakness of the nervous system, brought on by the previous illness, will show itself in this no less than in other alterations of function. This can frequently be observed in convalescence, not only from the specific fevers, but also from pneumonia and other acute febrile diseases, when trifling external influences may cause a considerable rise of the temperature, which, however, is generally of short duration only, but which, in the case of specific fevers may cause apprehension lest a relapse be coming on. In a somewhat different manner, and more lasting, a slight sub-febrile elevation of temperature may be observed in the convalescence from acute rheumatism, where it may persist for weeks without any joint- or heart-symptoms being present.

Significance of Abnormal Temperature for Diagnosis and Prognosis.— The maintenance of the heat of the body at a certain range being so insured, any deviation of the general temperature from the normal standard, however slight in degree, and unless of a very transient nature or brought on by evident external causes, is to be taken as a sign of disease. Such deviation may be of a variable degree, along with symptoms which, in part, are the consequence of the abnormal temperature, such as an abnormal rate of pulse and respiration, and nervous symptoms. The whole range of deviation within which life can well be maintained is comprised between 90° Fahr. (32·3° C.) and 110° Fahr. (43·4° C.). A temperature approaching either end of this range indicates a condition of extreme danger, which is already great with a temperature of 95° Fahr. (35° C.), or beyond 106·5° Fahr. (41·5° C.). With reference to the general condition of a patient who presents an abnormal temperature, a few distinctions may be conveniently tabulated:—

1. *Temperature below the normal*:—

*a.* Temperature of collapse, below 97° Fahr. (36·2° C.)

*b.* Subnormal temperature, 97–98° Fahr. (36·2–36·7° C.)

2. *Normal temperature*: 98·0–99·5°Fahr.(36·7–37·5° C.).

3. *Temperature above the normal*:—

*a.* Subfebrile temperature, 99·5–100·5° Fahr. (37·5–38·05° C.).

*b.* Febrile temperature of moderate degree, 100·5–102° Fahr. (38·05–38·88° C.), morning; 102·2–103° Fahr. (39°–39·44° C.), evening.

*c.* Febrile temperature of high degree, 102·5° Fahr. (39·2° C.), and more in the morning; 105–106° Fahr. (40·6–41·1° C.) in the evening.

*d.* Hyperpyrexia, 105·8–107·5° Fahr. (41–42° C.) and more. Extremely dangerous.

**Single Observations.**—Near the ends of this scale a single observation of the temperature

of a patient may at once decide the prognosis. Thus a temperature below 93° Fahr. (33·88° C.), or above 108° Fahr. (42·22° C.) is almost always fatal, although cases have been recovered by active treatment in which the latter point has been exceeded by several degrees. No less valuable may single observations be for diagnosis, chiefly in a general way, in showing that there is disease when, perhaps, no other symptom points to it, but also for the diagnosis of a special disease in some instances. Where there are other symptoms of disease, the discovery of an abnormally high or a febrile temperature may at once give quite a different aspect to a case, as, for instance, when a patient who has been suffering for some time from a troublesome cough, but in whom the most careful examination of the chest could not detect any lung-disease, is found to have pyrexia. The suspicion that there is commencing phthisis may thereby be at once confirmed, or aroused for the first time. Or, again, in a case where the patient simply complains of dyspepsia and lassitude, the thermometer may give a degree of heat which would not have been expected either from the looks of the patient, or from the temperature of his hands or chest, and the attention may thereby at once be directed to the possibility of the case being one of typhoid or some other specific fever. One reservation must be made with regard to single observations in patients who have not been kept at rest for some time before, for example, in patients who have walked to the physician's house, or who had to undergo a journey to the hospital. In such cases the temperature may be somewhat altered by the fatigue; and it is quite common to find the first temperature in a patient, immediately after his admission into the hospital, considerably higher than after a few hours' rest, or, if he have been exposed to cold, much lower than what would otherwise correspond to his condition.

**Systematic Series of Observations.**—But of much greater value than isolated observations of temperature is the regular and continued watching of the course which the temperature takes in a disease. Many diseases present a deviation from the normal temperature showing a typical course as regards the duration, as well as the daily fluctuations, of the abnormal temperature. The course of its temperature being part of the natural history of a disease, the study of this is of great importance for diagnosis.

Types of Pyrexia.—First, it is *the mode of rising* of the temperature which varies, and by which some diseases may be distinguished. In some diseases a contraction of the peripheral arteries takes place at the onset, which, by diminishing the peripheral circulation and the giving off of heat, leads to a rapid rise of the internal temperature, and is accompanied by a sensation of cold. In pneumonia, therefore, and other diseases commencing with a rigor, the temperature rises rapidly and continuously to a height of 104° Fahr. (40° C.) or more; whereas diseases with a more gradual beginning show simply a slow elevation of the normal range, both morning and evening temperature becoming gradually higher, and the usual daily fluctuation being maintained. Thus, in typhoid fever the temperature rises every day about 2° Fahr.; but the temperature going down again in the morning, the maximum of about 105° Fahr. is only attained on the fifth or sixth day.

At *the height of a disease* the temperature may fluctuate round an average temperature of about 103° Fahr. (39·5° C.) or more, whilst it shows the same daily course as in health, that is, being lowest in the morning and highest in the evening. The range of this daily fluctuation may, however, differ considerably in different diseases; and according to the extent of the daily fluctuation, three types may be distinguished. When the daily fluctuation of an elevated temperature shows only the normal difference, or even a smaller difference, between the morning and evening temperatures, we speak of *continuous*, or, more correctly, *sub-continuous* pyrexia; when the difference is greater than the normal, the remission having a tendency to a low temperature, and the exacerbation, on the contrary, to a considerable rise, the pyrexia is called *remittent*; and, thirdly, when the remissions reach the normal, or recede even below it, we have the *intermittent* type of pyrexia.

A *continuous* elevation of temperature is observed soon after the commencement of a disease, and during its height.

Considerable *remissions*, or even intermissions, of the febrile temperature are principally observed in the decline of some acute diseases, and in chronic inflammatory diseases, especially of a tubercular nature, or in chronic syphilitic affections, the remissions generally becoming more marked as the exhaustion of the patient increases.

The *intermittent* type of pyrexia is most typically shown in malarial diseases, in which the elevation of temperature may follow a quotidian, tertian, or quartan type. The same also sometimes occurs in chronic tubercular disease of the lungs. Pyrexia of a remittent type may present a peculiarity which is worthy of note, as being of some diagnostic value. Whereas in the great majority of cases the daily fluctuation follows the rule of health, the exacerbation taking place in the evening, we sometimes meet with cases where this order is reversed, the rise taking place in the morning, and the remission occurring in the evening. This 'inverse type' as Traube called it, of the daily fluctuation of a febrile temperature has been observed in some rare instances in typhoid fever; more frequently in cases of chronic lung-disease; whilst in doubtful cases of inflammation of the lungs it has some significance as to the disease belonging to the class of phthisis.

Slight deviations in the maximum daily rise of a febrile temperature occur sometimes in this way, that the height is reached in the middle of the day, or that the exacerbation takes place in the night, or that two or more considerable elevations, instead of one only, take place in the twenty-four hours. Such occurrences, which have been observed in typhoid fever and in phthisis, can, of course, only be found out by the observations of the temperature being repeated with sufficient frequency. A more frequent application of the thermometer will also be neces-

sary in some cases of ague, where the attacks are not well-marked, or occur in the night, in order correctly to judge of the case.

The *decline of the elevation of temperature*, at the termination of a disease, may be gradual, the daily fluctuation, however, taking place as usual; or it may be rapid, by a continuous sinking of the temperature to, or somewhat below the normal, in the course of from twelve to thirty-six hours, or even in six to eight hours, as in relapsing fever. The latter mode of termination of a fever is called *crisis*, whereas the former is designated *lysis*. A crisis may sometimes be accompanied by symptoms of collapse, and, in some rare instances, by acute delirium, which, however, generally passes off within a day or two, and is not of bad omen provided the general condition of the patient remain good. Symptoms of this kind, as well as a more considerable elevation of the temperature just previously to its fall, or a great irregularity in the course of the temperature preceding it, may be called *perturbatio critica*. It would appear that diseases caused by the action in the system of some foreign substance—as, for instance, some infective agent, its action being of a limited duration—have a tendency to a critical defervescence. Diseases, on the contrary, in or by which an organ has become materially altered, as by an injury, or in the course of an infectious disease of longer duration, show a slow decline of the pyrexia, with a tendency to a remittent type. The repair of the damaged structures taking some time, the decline of the pyrexia is slow, and the defervescence by lysis. Examples of the former mode of defervescence are furnished by acute pneumonia, erysipelas, typhus, relapsing fever, and measles when not complicated by more serious inflammation; the latter type is shown by typhoid fever, in which the specific process produces deep alterations in the glandular structures of the intestine, which persist for some time after it has terminated. The same is observed whenever an organ is altered by an inflammatory process, be this of a traumatic or of an infectious origin. The ancient physicians believed that a crisis took place with preference on certain days, as, for instance, the seventh day of an illness; but more extended experience, gained by means of the thermometer, has shown that, although a change or a termination of a disease take place at a certain definite period, the latter is not bound to one particular day. *See* Crisis.

Any *irregularity of the course* of the temperature in a disease in which, as a rule, it runs a very regular and definite course, is indicative of some disturbance or complication, and its early detection is therefore important for diagnosis, no less than for prognosis and treatment.

On *the approach of death* the temperature in many cases gradually sinks; but instances are not of rare occurrence in which, on the contrary, especially in diseases with high fever, a continuous rising takes place towards the fatal termination, reaching sometimes hyperpyrexic degrees.

In *convalescence* the temperature is more easily influenced by external causes, as well as by internal changes, and the approach of a relapse or complication being at once indicated by a rise of temperature, the continuance of regular thermometrical observations in the first period of convalescence is of very great importance; the more so as convalescents are sometimes not sensible to changes, which at first only show themselves in an alteration of the temperature.

Treatment.—Abnormal states of temperature ought not, as a rule, to be considered as objects of treatment by themselves, all the concomitant symptoms, in fact the whole state of the patient, having to be taken into consideration, in order properly to treat a case of febrile disease. But there are exceptional cases in which the state of the temperature at once urgently requires a symptomatic treatment. Such are, for instance, cases of hyperpyrexia in sun- or heat-stroke, in which the most energetic means ought at once to be applied to reduce the temperature. As the experience of American physicians has shown, life may in such cases sometimes be saved by continually rubbing the surface of the body with large pieces of ice, using at the same time stimulants by the rectum or subcutaneously. A rapid abstraction of heat by rubbing with ice, or cold bathing with affusions, may also be the only means of saving a patient in whom, in the course of acute rheumatism, hyperpyrexia has set in; and a case published by Dr. Wilson Fox in which the temperature reached 110° in the rectum, is very instructive in showing that external cooling may be successful, when even very large doses of quinine (120 grains had been given in six hours), had been administered without effect. The same plan must be followed in hyperpyrexia occurring in the course of other diseases. Complications, such as pneumonia, do not contraindicate this treatment, the success of which is, however, dependent upon the possibility of rousing the nervous system, and upon the circulation remaining sufficiently active.

An abnormally low temperature requires the external application of heat, which will be materially assisted by warm stimulating drinks or injections, using eventually subcutaneous injections of ether or of tincture of musk, to stimulate the action of the heart.

Apart from such exceptional cases, the treatment of the abnormal states of the temperature must be subordinated to the general treatment of the case. In many cases the abnormal temperature being dependent upon some local cause, the removal of the latter will make the abnormal temperature also disappear, or at least reduce it—an experience with which surgeons are quite familiar.

Rise of temperature being, however, the chief and most important symptom of pyrexia, leading of itself to serious consequences, especially by weakening the heart's action, it becomes necessary in many cases of protracted febrile disease, besides the general or special treatment which the case requires, to treat the febrile temperature symptomatically. It has now been shown by an overwhelming experience that the course of the specific fevers, such as typhus, typhoid, scarlatina, although it cannot be cut short, can yet materially be influenced, by keeping the febrile temperature artificially down, by means of cold baths or wet packing, and by antipyretic medi-

cines. And it is very important not to wait in a case with continuous high temperature until symptoms of failure of the heart's action—a weak pulse, cold extremities, cyanosis, and congestion of the lungs, and muttering delirium—show themselves, but to try to prevent these symptoms by keeping down the temperature. Patients treated early on this principle will be found much less frequently to pass into that state, to sleep more soundly, and to retain their appetite; bedsores and other serious complications being of much rarer occurrence; and it has been established that the mortality in specific fevers has by the antipyretic treatment been considerably diminished, and that convalescence also is quicker than in cases treated on the expectant plan.

In the symptomatic treatment of pyrexia in acute disease, and especially in the continued fevers, it is best to follow the principle laid down by Liebermeister, than whom no one has had more experience in these matters. Starting from the fact that a febrile elevation of temperature, of a remittent type, is much better supported by the patient than a temperature of even a lower degree, but which has a more continuous course, the object he has in view is, by the anti-pyretic treatment, to increase the remissions that normally take place every day, and to prolong them as much as possible. Comparative experiments have shown that external cooling by baths, and other means, as well as antipyretic medicines, are of greatest effect at those times of the day when the temperature spontaneously has a tendency to decline. In order to attain the greatest antipyretic effect with the least frequent repetition of baths, the most suitable time for the latter, according to Liebermeister, is the night; and the antipyretic medicines may be given to assist and prolong the effects of the baths.

As regards external cooling, by far the most effective means are cold baths of 60° to 70° Fahr. (15° to 20° C.), and about ten minutes' duration. More agreeable to the patient are baths of about 95° Fahr. (35° C.), gradually cooled down by the addition of cold water to 70° Fahr. (20 C.), or less, but their duration must be longer to have the same effect as the former (*see* Hydrotherapeutics). Cold wet-packing is less effectual, but may replace baths in patients of small volume (*see* Cold, Therapeutics of).

Quinine, in order to derive the greatest effect from its use, ought to be given in one large dose, 20 to 40 grains, in the evening, its action being slow and passing off slowly. Salicylic acid, on the contrary, and its soda-salt, which produce a fall of the temperature much more quickly, but also much less durably, are best given in a dose of 60 to 120 grains in the night or towards the morning. Neither these medicines nor cold bathing must, however, be used in a routine way, many things having to be taken into account in their use and in judging of their effect, as the time of the day, the severity of the case, and, not least, the individuality of the patient.

C. G. H. Bäumler.

**TENDERNESS.**—This word, in relation to medical and surgical practice, usually implies that pain, in various degrees and of different kinds, is elicited by pressure, as distinguished from the sensation which is felt spontaneously by the patient. The term might conveniently be made to include all painful sensations elicited by any physical disturbance of a part, as, for instance, the movement of a joint, or the pressure of its structures against each other. The like observation applies to any irritation of the mouth or throat, when these parts are the seat of disease accompanied by tenderness; as well as to other mucous surfaces.

Tenderness is a symptom often of great importance, and it claims the careful attention of the practitioner. It is often present when there is no complaint of pain on the part of the patient; while, on the other hand, it is by no means a necessary accompaniment of spontaneous pain; its very absence is frequently of much consequence in diagnosis. In an investigation for the purpose of eliciting tenderness, care is required, especially in certain cases; and the examination should be made with gentleness and restraint, so as not to give the patient unnecessary pain, or to produce other effects, which might prove serious in some instances. It may be that only a slight touch can be borne, but pressure may be gradually increased, if necessary, until tenderness is produced; it must be noted what degree of pressure is needed to cause the sensation. The observer must thus endeavour to fix upon the structure in which the tenderness is located; as well as to measure the intensity of the feeling. Its limitation in extent must also be determined. The patient can often give useful information as to its exact character. Care, however, is necessary to guard against being misled by malingerers, hysterical persons, or those who have imaginary ailments; and also not to mistake tenderness for mere hyperæsthesia of the skin. For this purpose it is of much help, among other points, to watch the patient's expression of countenance whilst pressure is being made. Hysterical patients may seem to suffer acutely when slight pressure is made; but if this be gradually increased, while their attention is diverted by conversation, it is found that the suffering is not real. It must also be remembered that some persons are much more sensitive than others.

Value in Diagnosis.—Without attempting to treat the subject exhaustively, a few hints may be offered as to the diagnostic relations of tenderness, and as to the more prominent diseases and conditions in which the presence and degree of this symptom are of essential service in indicating their existence.

When pain is complained of, the presence or absence of tenderness, and its degree, may be of signal value in diagnosing the kind of painful sensations to which it belongs. For instance, it may be affirmed, as a general rule, that the pain of inflammation is accompanied with tenderness, and especially so if the condition is superficial, has ended in suppuration, or involves nerves. On the other hand a purely neuralgic pain is on the whole free from tenderness, and is not uncommonly relieved by pressure, although there are certain localised 'tender points' in some forms of this complaint, and these are also of significance. Hence, when pain is evidently seated in a particular nerve or nerves, pressure may determine whether they are actually involved in

some inflammatory mischief, or merely functionally disordered. Again, the pain of muscular rheumatism, when not inflammatory, is often relieved by pressure; while spasmodic muscular pains are usually thus greatly alleviated, so that patients of their own accord press upon the affected part. In this way a very obvious and decided distinction is frequently afforded between spasmodic and inflammatory conditions involving the abdominal structures. Further, in connection with tumours and growths, those which are of a malignant nature are often accompanied by pain and tenderness, while those which are benignant may be said to be, as a class, free from such symptoms. Marked tenderness may be an important sign of destructive changes, such as those which occur in some diseases of joints, or as a result of the pressure of an aneurism or other tumour, where there is at the same time spontaneous pain. Very limited and obvious tenderness may indicate the seat of a foreign body, lodged in the soft parts or irritating them, especially if it should be pointed, as, for instance, a needle.

It must be remembered, in the next place, that tenderness may be a valuable diagnostic sign, when there is no complaint of pain on the part of the patient. For example, it may reveal joint-disease, not previously known to exist. The writer has found this symptom of great assistance in recognising the presence and situation of obscure limited disease in the abdomen, such as cancer, ulceration, or suppuration. It may also lead to the discovery of undetected suppuration. In the case of children who are too young to complain, but who, on account of their crying, may be supposed to be suffering, an unusual manifestation of pain during their examination must be carefully looked for and attended to, as useful information may thus be obtained. It may be mentioned that general tenderness is in some instances a striking symptom of commencing rickets in children. In the case of ulcers, in order to determine their condition for purposes of treatment, it is worth while to notice whether they exhibit tenderness, as well as its degree. Some ulcers are indolent, and scarcely at all sensitive; others are extremely irritable, and cannot be touched.

These illustrations will suffice for the general diagnosis of tenderness, and it now remains but to point out some of the complaints in which this symptom is peculiarly prominent. Amongst these may first be mentioned superficial inflammatory affections, such as acute erythema or erysipelas, and also any condition ending in suppuration. Peritonitis is usually attended with remarkable tenderness, either generally distributed over the abdomen, or localized, according to the seat and extent of the disease. Here, however, it is necessary to guard against being misled by certain hysterical cases, in which there is intense hyperæsthesia of the skin covering the abdomen, but the distinctions already pointed out should prevent any mistake in diagnosis. Gout affecting the joints is generally accompanied by exquisite tenderness, much more than in other forms of articular disease, although affections of the joints generally give rise to tenderness. Hysterical patients are again liable to mislead the practitioner in this direction, as they sometimes seem to be intensely tender about a joint, when there is really nothing the matter with it. There is also a peculiar complaint met with in these subjects, called 'spinal irritation,' in which exquisite tenderness is experienced along the spine, or over some of the spinous processes (*see* Spinal Irritation). Amongst other conditions which are attended by peculiar tenderness may be mentioned corns and bunions, neuromata; certain stumps after amputation; boils; whitlows; and many affections involving such sensitive structures as the eye, or the matrix of the nails.

Treatment.—In the first place, of course, the disease with which tenderness is associated must be treated independently of this particular symptom, although it may afford useful indications. For example, it may reveal suppuration, when an incision will give vent to the pus, and relieve the tenderness. For the nervous and hysterical conditions in which tenderness is a prominent symptom, general treatment directed to the particular condition present is essential. When a part is really tender, all pressure must be avoided, or even, in some instances, the mere touch of such articles as clothing or bed-clothes. For instance, in cases of acute inflammation of joints, or in peritonitis, it is of great service in treatment to raise the bed-clothes by means of cradles, so that they do not come into contact with the patient. Hot and cold applications, anodynes, and allied agents may be employed locally with good effect in many conditions for the purpose of diminishing undue sensibility. *See* Hysteria; Pain; and Spinal Irritation.

Frederick T. Roberts.

**TENDON-REFLEX.**—*See* Spinal Cord, Diseases of; page 1458.

**TENDONS, Diseases of.**—Synon.: Fr. *Maladies des Tendons*; Ger. *Krankheiten der Sehnen.*

Although simple in their structure, and performing a purely mechanical function of a passive kind, tendons and tendon-sheaths are liable to a considerable variety of diseases. In some instances these diseases are *primary*, and originate in the fibrous and synovial structure of the parts involved; whilst in other instances they are *secondary* to morbid conditions of the muscles, joints, and fasciæ with which the tendons are connected. The primary injuries and diseases alone call for notice here.

**Injuries.**—Tendons are subject to a variety of injuries as the result of violence, such as partial or complete rupture of the tendon proper; rupture of the sheath; dislocation; incised wounds; and, most common of all, sprain of its fibres.

**Inflammation.**—Inflammation of a tendon and its sheath may be traumatic in origin, but it frequently makes its appearance without obvious cause, and then constitutes one form of whitlow (*see* Whitlow). Certain effusions into the synovial sheaths may be regarded as of a chronic inflammatory nature.

**Rheumatic affections.**—Of greater frequency and importance are the affections of tendons and tendon-sheaths, which occur in acute and chronic rheumatism, in rheumatic arthritis.

and gonorrhœal rheumatism. These will be found fully described in the several articles on those subjects. In acute rheumatism, and in the early stage of gonorrhœal rheumatism, the involvement of the tendon-sheaths may give rise to nothing more serious than pain and stiffness; but in protracted cases of the gonorrhœal affection, and in rheumatic arthritis, permanent changes may result, including contractions, adhesions, calcification, and even complete destruction.

**Gout.**—The tendons and their synovial sheaths are by no means an uncommon seat of gouty deposit. This condition is probably best marked in the extensor tendons of the hand, giving rise to a characteristic form of rigidity, or false anchylosis of the finger-joints.

**Ganglion.**—This affection is usually a local dilatation of a tendon-sheath, or a cystic formation in connection with it. In the opinion of the writer it is especially common in rheumatic subjects. *See* GANGLION.

**Deformities.**—The most obvious and the most common deformities involving tendons are of the nature of contractions, such as give rise to club-foot and distortions of the fingers. As a rule, these are the result of some of the morbid conditions already referred to, but in other instances they are of more obscure origin. Thus, in the so-called 'Dupuytren's contraction of the palmar fascia,' a highly characteristic deformity of the fingers and palm of the hand results from a kind of stricture of the sheaths of the flexor tendons of the fingers and wrist, due to shortening of the fibres connecting them with the palmar fascia. In several cases of this nature the writer has found marked thickenings of the extensor tendons also, where they are in relation with the inter-phalangeal joints.

**New growths.**—Various new growths of a fibrous, cartilaginous, osseous, or malignant nature have been found in connection with tendons.

SYMPTOMS.—The symptoms connected with diseases and injuries of tendons are chiefly of an objective and easily recognisable kind. The most obvious of these is impairment of movement of the tendon in its sheath, and of the associated muscles and joints. In its slightest degree, such impairment amounts only to stiffness; but when it is more marked, it may take the form of rigidity, or even complete loss of function. Deformities may then very readily arise in connexion with the joints, such as unnatural flexion or extension, or actual dislocation; whether referable to shortening of the tendon, to constriction of its sheath, to prolonged disuse of the joint, or to wasting of the associated muscles with over-action of their opponent groups. Similar results may follow rupture, wounds, or destructive ulceration of tendons.

Traumatic, rheumatic, and gouty effusions into tendon-sheaths give rise to swellings along their course, which are easily recognised if the anatomical relations of the parts be remembered, but which are probably often mistaken for intra-articular disease. Localised swellings on tendons, such as ganglia, nodules, and new growths, present unmistakeable characters.

The chief subjective symptoms connected with the diseases of tendons are pain and a feeling of stiffness. Both of these symptoms vary greatly in different instances, and neither is perhaps characteristic of affections of these structures, apart from the associated muscles, bones, and ligaments.

TREATMENT.—The treatment of diseases of tendons, where it is not of a strictly surgical nature, is fully described in the several articles in this work, to which reference has been made.

J. MITCHELL BRUCE.

**TENESMUS** (*τείνω*, I stretch),—SYNON.. Fr. *Ténesme*; Ger. *Stuhlzwang*.—A certain group of morbid sensations referred to the anus and its vicinity have been thus named. There is a feeling of fulness and weight, with frequent or constant inclination to go to stool, and straining during the act of defæcation, little or nothing being passed, and that often of the nature of slimy mucus or blood, while no sense of relief is experienced afterwards. Tenesmus is a common symptom in cases of dysentery. It may also be associated with local diseases about the lower part of the rectum or anus, such as piles, fistula, or malignant disease. Other sensations are often present at the same time.

TREATMENT.—Any local cause of tenesmus must be removed or cured, if practicable. The sensations are best relieved by local applications of heat or cold, or by the use of small enemata containing laudanum, or of suppositories of morphia or extract of belladonna.

FREDERICK T. ROBERTS.

**TEPLITZ, in Bohemia.**—Simple thermal waters. *See* MINERAL WATERS.

**TERMINATIONS OF DISEASE.** *See* DISEASE, Terminations of.

**TERTIAN** (*tertius*, the third).—A term applied to a form of intermittent fever, in which the paroxysms return on the third day, or at an interval of about forty-eight hours. *See* INTERMITTENT FEVER.

**TERTIARY** (*tertius*, the third).—This word is usually associated with the advanced forms of syphilitic disease. *See* SYPHILIS.

**TESTES, Diseases of.**—SYNON.: Fr. *Maladies des Testicules*; Ger. *Krankheiten der Hoden*. The diseases of the testes will be discussed in the following order:—1. Abnormalities of development; 2. Hypertrophy; 3. Atrophy; 4. Injuries; 5. Acute Inflammation; 6. Chronic Inflammation; 7. Hernia Testis; 8. Cystic Disease; 9. Fibroma; 10. Chondroma; 11. Malignant Disease; 12. Teratoma; and 13. Neuralgia.

1. **Abnormalities of Development.**—(*a*) *Absence.* There may be complete absence of the testicles. The subjects of this imperfection, if they attain the age of puberty, present the ordinary characteristics of eunuchs. As the complete gland is formed from two distinct parts, the failure or arrest of development may be limited to either part, separately from the other. Thus cases are described where a well-developed vesicula seminalis and vas deferens have been found, without any trace of a testicle; and others,

where a testicle existed with complete or partial absence of the vas deferens.

(*b*) *Excess.* — Supernumerary testicles have been described, and men not unfrequently believe themselves to be so gifted. The mistake has arisen from the presence of encysted hydroceles, or of fatty or fibrous tumours of the cord, or of an old epiplocele. There is no well-authenticated case recorded of the presence of more than two testicles.

(*c*) *Malposition.*—The testicles, which are developed in the abdomen, immediately below the kidneys, are at birth, or shortly after, lodged in the scrotum. This change of position is frequently described as 'descent of the testicle,' an obvious misuse of words, if regard be paid to the usual position of the fœtus in the uterus.

The testicle may be retained in the *abdomen*, or in the *inguinal canal*; or may pass through the inguinal canal into the *perineum*, and be lodged between the bulb of the urethra and the anterior part of the tuber ischii, or over the external pillar of the ring into the subcutaneous tissue of the *upper part of the thigh*; or may pass through the crural canal to the *upper and inner part of the thigh*; or, if it has passed into the scrotum, may be *rotated*, so that the epididymis is in front and the testicle behind. More rarely it has the long axis transverse instead of oblique; or it may be completely inverted, so that the globus major is below, the globus minor above.

Retention in the abdomen or inguinal canal may be the result of adhesions from intra-uterine inflammation, or of disproportion between the gland and the orifices through which it has to pass, or of some constricting band. The passing through the crural canal to the thigh, or through the inguinal canal to the perineum or thigh, must be the result of some unusual attachment of the lower end of the gubernaculum. Malposition in the scrotum must be caused by some abnormality in the development of the cord.

The consequences will vary with the position. If the testicle is retained in the *abdomen*, the corresponding half of the scrotum remains undeveloped, and the gland is always much smaller than normal. Sometimes there is an arrest of development, or it undergoes fatty or fibrous degeneration, or if otherwise normal, does not secrete a fertilising fluid. This seems fairly established by numerous observations, both in men and the lower animals, where the testicle has been abnormally retained in the abdomen. One case, however, has been recorded by Hutchinson, where the observer, to whom the retained testicle was submitted for microscopic examination, stated that he found numerous spermatozoa.

When the testicle lies at the internal inguinal ring, the epididymis is frequently found partly in the badly-developed scrotum, into which also extends the processus vaginalis. As the communication between this and the peritoneal cavity is usually maintained under such conditions, in case of peritonitis with peritoneal effusion there may be distension of this process, so as to greatly simulate a hernia, and render an exploratory examination necessary.

Retention of the testicle in the *inguinal canal* is more liable to complications than retention in the abdomen. It is often accompanied by inguinal hernia; is more exposed to injury; and when enlarged at puberty, or by inflammation, may cause severe pain from constriction by the surrounding parts.

Inflammation of a testicle retained in the inguinal canal has been mistaken for strangulated bubonocele, or for a bubo. Careful examination of the scrotum should, therefore, be made in doubtful cases.

Retraction can usually be distinguished from retention of the testicle by the state of development of the corresponding half of the scrotum.

The *perineal* or *femoral* position of the gland is not of necessity attended with any bad results. A testicle, however, so situated, is usually smaller than normal and is more exposed to injury. This is especially the case in the perineal position.

Treatment.—If retention of the gland in the inguinal canal be attended with any inconvenience, operative interference may succeed in placing it in the scrotum. But if this should fail from shortness of the cord, extirpation would be necessary. When in infants retention of the testicle is complicated by an inguinal hernia, the use of a truss is not to be recommended, as it will prevent the possible descent of the testicle, and the hernia not infrequently spontaneously subsides. If the retention of the gland be permanent and cause inconvenience, it is better to remove it at once. If the gland have passed through the crural canal, nothing can be done to remedy the malposition; but when it has passed through the inguinal canal into the perineum or the thigh, an attempt may be made to place it in the normal position. In an adult, such a proceeding would be hopeless, from the non-development of the scrotum. In infants, the attempt has been twice made at the London Hospital, by Curling and James Adams. Both cases died, and in the second, in which alone a *post-mortem* examination was allowed, acute peritonitis was found, which had extended from the pervious processus vaginalis. With antiseptic precautions, however, better results might be anticipated.

Mr. John Wood has successfully transplanted in an infant a testicle from the perineum to the scrotum subcutaneously. When a band of tissue in the perineum, probably the gubernaculum, had been divided with a tenotomy knife, the gland could be pushed up to the inguinal canal, and from thence into the scrotum, where it was retained by a harelip-pin passed above it as in acupressure. This method, when practicable, would be unattended with danger. But as sometimes the unaided efforts of nature draw the gland from the perineum up to the inguinal ring, where it is comparatively safe from injury, and more favourably situated for any attempt at removal to the scrotum, it is advisable always in infants to allow time for such a possible modification, which might moreover be encouraged by electric stimulation of the cord.

Of malpositions in the scrotum, that where the epididymis is in front, and the testicle proper behind, is alone of any practical importance. In any operation for hydrocele or hæmatocele of

the tunica vaginalis, the position of the testicle ought first to be ascertained.

(*d*) *Arrest of Development.*—This sometimes occurs after the testicles have passed into the scrotum, so that these glands remain permanently in their infantile condition. No general cause has been discovered for this abnormality.

2. **Hypertrophy.**—When only one testicle has been retained in the abdomen, the other sometimes attains an unusually large size. Such cases of, as it were, compensating development, are, however, the exception and not the rule.

3. **Atrophy.**—Wasting of the testicle may result from inflammation, or from lesions of the spinal cord caused by injury or disease, or subsequently to injuries of the head. It may also be produced by early and excessive venereal excitement; or by deficient blood-supply, due to aneurism or other causes. It is frequently found associated with varicocele.

4. **Injuries.**—These glands are greatly protected from accidental violence by their mobility, and the laxity of the surrounding structures. Immediate death has resulted from severe contusions of the testicle, probably from reflex inhibition of the action of the heart. Contusion and wounds require appropriate surgical treatment.

5. **Acute Inflammation.**—When acute inflammation attacks the body of the gland solely or chiefly, it is called *orchitis*; when the epididymis, *epididymitis*. For the comparatively rare cases in which the vas deferens, or this duct along with the other structures of the spermatic cord, is affected, without the testicle being implicated, the barbarous hybrids, *deferenitis* and *funiculitis* have been coined.

Ætiology.—Acute inflammation may be caused by direct violence, or by the extension of inflammatory processes from the mucous membrane of the urethra. It may also occur, though rarely, as a sequela in small-pox or in pyæmia. It is not infrequently a concomitant of parotitis or mumps.

Of these varieties, the most frequent is gonorrhœal epididymitis. This was at one time regarded as an instance of 'sympathetic inflammation.' Careful examination will, however, always prove that the vas deferens is also affected, though sometimes in so slight a degree that its participation in the inflammation might easily escape notice. This form is, therefore, due to direct extension of the inflammation of the urethral mucous membrane. Orchitis associated with mumps has been generally regarded as an instance of 'sympathy,' or 'metastasis.' Kocher, however, considers it to be the result of urethritis. According to this experienced observer, the disease commences as stomatitis, by which the parotid, or sometimes the submaxillary and neighbouring lymphatic glands become infected. The morbid material is carried by the blood to the kidneys, and in its course through the urinary passages sets up cystitis or urethritis, and thus the orchitis results. The question cannot, however, be regarded as finally decided. Orchitis and epididymitis sometimes occur in rheumatic or gouty subjects. Occasionally cases are met with in which no exciting cause can be discovered.

Symptoms.—The symptoms of orchitis are local pain and swelling, with, in cases of orchitis sometimes, and in cases of gonorrhœal epididymitis frequently, redness and tension of the corresponding part of the scrotum. Severe lumbar pain is in some cases felt, especially by labouring men, who apply for relief on account of some supposed sprain or injury, being either ignorant of, or attaching no importance to, the affection of the testicle. This is probably due to inflammation of the lumbar lymphatic glands, with which the lymphatics of the testicle freely communicate; but it may possibly be an example of 'referred sensation.'

Prognosis.—The prognosis is good. The inflammation usually subsides speedily, and leaves the gland in a healthy condition. Atrophy sometimes results after inflammation associated with mumps, or caused by severe contusion. Chronic induration of the epididymis may persist; but after some months it usually disappears. Stricture of the epididymis, or of the vas deferens, is very rare. Suppuration does not occur except in pyæmia, or after small-pox, or in strumous and very enfeebled persons.

Treatment.—Rest in the recumbent position, with the scrotum supported by a crutch-pad, and the application of ice locally, are in ordinary cases sufficient. Where rest is impossible, well adjusted strapping of the part affords considerable relief, and promotes absorption of the products of inflammation so rapidly as not infrequently to necessitate the re-application of the strapping within twenty-four hours. Attention to diet and avoidance of all violent exercise will be requisite. In more protracted cases, mercury, taken in small doses internally, or applied locally by inunction, or on strapping, will be found of benefit. The practice, recently recommended by some eminent surgeons, of puncture or incision of the ordinarily inflamed gland, is, according to the writer's experience, never necessary. If suppuration, however, occur, a free incision should be made as early as possible.

6. **Chronic Inflammation.**—Chronic orchitis may sometimes be the result of an acute attack, but is much more frequently induced by *syphilis*, *struma*, or *gout*.

(*a*) *Syphilitic Orchitis.*—Description.—This may occur in young children who are the subjects of inherited syphilis, in the form of hard nodules in the testicle. In adults it belongs to the tertiary stage of the disease, but is very often symmetrical. It is usually painless, the patient being frequently ignorant of its existence. The gland is enlarged, very hard, insensitive to pressure, and often nodular in form.

Treatment.—This form of orchitis is usually very amenable to treatment, but has a tendency to recur. Iodide of potassium combined with mercury in small doses internally, when it can be tolerated, and strapping locally, will in most cases produce rapid disappearance of the disease, for a time at any rate. Atrophy may sometimes result; and in some cases suppuration, with the formation of troublesome sinuses, may occur. In one case under the notice of the writer, which was complicated by an inguinal hernia, the gland had, after very prolonged and unsuccessful treatment, to be removed, as the use of a truss caused

great pain, and the non-use of it led to a dangerous descent of the hernia.

(*b*) *Strumous Orchitis.*—In most systematic works on surgery tubercular disease of the testicle is given as a distinct affection, but the descriptions of it are very confused, no two being in perfect agreement. This is partly because at one time the presence of caseous matter was regarded as evidence of tubercle, and partly because in many cases microscopic examination of the gland after its removal can alone determine the nature of the disease. Tizzoni and Gaule have, therefore, proposed to substitute the term 'phthisis' for 'tuberculosis' of the testis, since in this organ, as in the lungs, tubercular and non-tubercular processes, either separately or concurrently, run the same course.

Symptoms.—Tubercular disease of the testis is not rare in young children, and usually commences in the body of the gland. It occurs, however, much more frequently after puberty, and then commences, in the majority of cases, in the epididymis; the body of the gland and the vas deferens becoming subsequently infected in the progress of the disease.

A nodular swelling is found either in the gland or in the epididymis, which is usually only slightly, if at all painful, and runs an indolent course. After a longer or shorter time, this softens down into an unhealthy pus; adhesion and perforation of the superjacent structures ensue; and a fistula is formed. This condition may continue for a long time, but usually the disease extends to the rest of the glandular apparatus. Sometimes the testicle is very much enlarged. The vas deferens, if affected, may either be uniformly thickened, up to the inguinal ring; or present a number of distinct round or spindle-shaped enlargements. The prostatic portion of the duct and the vesicula seminalis are frequently similarly affected. Digital examination of these parts, through the rectum, ought therefore always to be made.

Treatment.—The treatment of strumous orchitis consists in careful attention to diet and hygienic conditions; in the use of cod-liver oil and iodide of iron; and in the protection of the part from accidental injury by a suspensory bandage. Abscesses should be opened as early as possible, and any fistula either laid open by incision or dilated by laminaria, and treated with stimulating lotions, such as nitrate of silver, of the strength of five grains to the ounce. In favourable cases the disease may be arrested, but in many cases removal of the gland becomes necessary. If the epididymis and the vas deferens are much involved, the gland, by obliteration of its duct, is functionally useless; and as there is always considerable risk of infection of the system generally, early removal of the gland is, in such cases, to be recommended. If the prostate and vesicula seminalis have become affected, this would, of course, be useless.

There is another form of caseous orchitis, not of tubercular origin, in which the intertubular lymphatic spaces of the testis become filled with a new growth of lymphoid tissue, by which the seminal tubules are ultimately compressed and destroyed. This may become transformed partly into fibrous tissue. but in the greater part usually undergoes fatty degeneration, forming caseous masses, which subsequently break down into curd-like pus. The symptoms are very similar to those of the tubercular disease, but there is not the same danger of general infection of the system.

(*c*) *Gouty Orchitis.*—Chronic orchitis from gout can be diagnosed by the history of the patient, and yields readily to the ordinary treatment for gout, but is very apt to recur.

7. **Hernia Testis.**—This morbid condition was formerly known as 'benign fungus of the testis.'

Description.—It consists of a fungous protrusion from the scrotum, of a red or yellowish-red colour, and varies from the size of a pea to that of a small egg. There are two varieties, which may be distinguished as *superficial* and *deep*. The superficial form springs from the visceral layer of the tunica vaginalis, and is very comparable to the fungous granulations occasionally met with in cases of suppuration, or in wounds of the synovial sheaths of tendons. In this the tunica albuginea is intact, but probably altered in structure. In the deep form the tunica albuginea has been perforated, and the protruded mass consists largely of seminal tubules. It cannot be regarded as an evidence of any special disease of the gland, as it may occur, but by no means necessarily, after any form of orchitis in which there has been suppuration.

Treatment.—The treatment consists in well-adjusted pressure upon the protrusion; with the occasional application of caustics, such as nitrate of silver or red oxide of mercury. Freeing the margins of the opening from adhesions, and bringing the thus liberated integument over the protrusion by means of sutures, is usually very successful. When the precedent inflammation has been due to some specific cause, the appropriate constitutional treatment must also be employed.

8. **Cystic Disease.**— Cysts are frequently found in the testicle, either separately or associated with other growths.

Description.—In true cystic disease or simple cystoma, the whole or part of the body of the testicle is replaced by a closely aggregated mass of cysts, of very variable size. Some are so minute as only to be visible on microscopic examination, while others may attain to the dimensions of a pigeon's egg. When only part of the gland is so affected, healthy glandular substance is found at the periphery, enveloping the cystic growth. The cysts have no proper wall, and are lined with shallow cylindrical epithelium, which is sometimes ciliated. They are filled with either clear watery, or sometimes very viscid, fluid; or with atheromatous matter, resembling the contents of a sebaceous cyst. Very frequently nodules of cartilage are found interposed between the cysts. The disease usually occurs in adults, but one case has been recorded where the enlargement was first observed at the age of three months. The structure seems to indicate very clearly the origin of the cysts to be from retention within the rete testis.

There is another form of cystic disease, where the cysts are separated by a considerable quan-

tity of gelatinous connective tissue, and often contain polypoid ingrowths, which sometimes completely fill their cavities. The tumour is often as large as a child's head. This form is regarded as cystic adenoma of the gland.

Cysts of the epididymis have been described in the article on HYDROCELE.

SYMPTOMS.—Cystic disease of the testicle is usually attended with very little pain. The tumour is of an oval form, either with a smooth surface, or with irregular elevations; and does not attain a very considerable size, being generally about as large as a goose's egg. There is an indistinct sense of fluctuation, unequal at different parts.

DIAGNOSIS.—Cystic disease has sometimes been mistaken for hydrocele or hæmatocele. The form of the tumour, its relatively greater weight, the absence of transparency, and the impossibility of detecting the body of the testicle at any part, distinguish it from hydrocele. The distinction from hæmatocele is in some cases more difficult. If exploratory puncture be considered requisite, a full-sized instrument should be used, as the fluid may be so viscid as not to flow through a small cannula.

TREATMENT.—Castration is the only remedy for this condition.

9. **Fibroma.**—Fibrous tissue is found in abnormal quantity in atrophy of the testis, in chronic orchitis, and associated with new growths. By fibroma of the testicle, however, is meant a new formation of fibrous tissue to a considerable extent, without any other important change. In structure it resembles fibrous tumours of the uterus. It so rarely occurs, however, as to practically be devoid of clinical importance.

10. **Chondroma.**—Cartilage, usually of the hyaline, but sometimes of the fibrous variety, is found in association with many new growths in the testicle. Pure chondroma is comparatively rare.

DESCRIPTION.—This form of tumour of the testis occurs as disseminated nodules, connected by fibrous tissue; or as elongated masses with branching processes. By compression of the seminal tubules, it leads to dilatation of other parts of the tubules; and by invagination of the walls of such dilatations, the growth often seems to be in the interior of a tubule. Careful examination, however, will always prove it to be of extra-tubular origin. It similarly invades the lymphatics, and through them has a great tendency to infect other parts of the system. It is often associated with myxoma; and sometimes, though rarely, it develops into bone. It can only be diagnosed with any certainty when the tumour has attained a large size, and is then characterised by the hardness and slow growth of the mass.

TREATMENT.—Castration is the only treatment; and in consequence of the tendency of this disease to invade other organs, the rule laid down by Mr. Curling is the best—'to recommend an operation without unnecessary delay, in all cases of large sarcocele which do not give any indication of yielding to treatment.'

11. **Carcinoma and Sarcoma.**—These are classed together, because, though histologically of very different origin, the distinction between them in any individual case is often impossible, except by microscopic examination of the tumour after removal. Even then the distinction is sometimes impossible, if we may judge from the description of recorded cases of mixed sarcoma and carcinoma.

The latter originates in the epithelial structures of the gland, and is almost invariably of the encephaloid variety. Scirrhus is said by all writers to occur sometimes, and so-called specimens are in many museums. According to Butlin, however, many of these are probably examples of fibrous sarcoma. Encephaloid cancer usually commences in the body of the testis, by the formation of one or more nodules. Sometimes the epididymis is first attacked. Very rarely is there general infiltration of the gland. In an early stage of the disease the gland is hard, from tension of the tunica albuginea, but when this has been destroyed in the progress of the growth, the mass is soft, and there is often distinct fluctuation. This may be unequal at different parts, from the presence of cysts. The growth is usually painless, but in some cases there is acute pain, either locally or in the lumbar region. The chief aids to diagnosis at this period are the rapidity of the growth, the enlargement of the blood-vessels of the cord, and the age of the patient. For while encephaloid cancer has been met with in young children and old people, still the vast majority of recorded cases have occurred between 20 and 40 years of age.

If the tumour attain a very large size, the scrotum may slough, and a bleeding fungus protrude. The disease has a great tendency to invade other parts of the system, and especially at an early period the lumbar lymphatic glands. This may lead to œdema of the lower extremities, from pressure on the abdominal veins. The inguinal glands generally escape infection, except in some cases where the scrotum has been involved in the disease. Secondary growths have been found in the mesenteric glands, liver, spleen, and lungs.

*Sarcoma* originates in the connective tissue of the testicle, and sometimes develops in both glands simultaneously. With microscopic examination two varieties can be distinguished, the round and the spindle-celled. The latter grows more slowly, and both are often associated with cystic and cartilaginous formations. The symptoms are very similar to those of cancer.

Sarcoma sometimes commences in the tunica vaginalis, and is then usually accompanied with extravasation of blood into the sac. The writer has met with two such cases, where the shape of the tumour, the complete absence of pain, the history of gradual enlargement, and the very distinct fluctuation were suggestive of hæmatocele. Exploratory examination, however, proved them to be cases of sarcoma. Castration was performed, and the testicles were found to be only slightly affected by the disease. Both cases died within a short period after the operations, from secondary affection of other organs, accompanied by similar hæmorrhages.

*Melanoma* of the testis was formerly regarded as a form of cancer, but is now considered to be sarcomatous. It is extremely rare, and in the few recorded cases of it, similar growths were found in many other organs of the body.

Diagnosis.—As a general rule it may be stated that sarcoma occurs most frequently under ten and after forty years of age; and that the epididymis is more frequently the primary seat of the disease, and, when secondarily involved, is attacked at an earlier period than in cancer. The distinction in any individual case must, however, be very uncertain, and is of little importance.

Prognosis and Treatment.—The prognosis is very unfavourable in both, as recurrence of the growth in other organs after the removal of the tumour is the rule to which there are but few exceptions. Castration is the only possible treatment for both diseases.

12. **Teratoma.**—The testis, like the ovary, may be the seat of cysts, containing hair, skin, bones, &c. The cysts are sometimes within, sometimes upon the gland. The more complex cases may be best explained as resulting from the inclusion of a second fertilised germ; while the simpler cases may be due possibly to the accidental grafting of the germs of such tissues on the rudimentary testicle. The history of a congenital tumour will suffice to direct attention to any such case. They are very rarely met with, and castration is the only suitable treatment.

13. **Neuralgia and Irritability.**—The testicle is sometimes the seat of very acute persistent or periodically recurring neuralgia. This must be distinguished from hyperæsthesia or irritability of the gland, which is occasionally associated with varicocele, or may be the result of self-abuse, excessive venery, or even of unsatisfied sexual excitement. Neuralgia may be due to some local cause, to varicocele, or to induration of some part of the glandular apparatus from precedent inflammation. It may also be sympathetic, as in renal colic, or where the digestive system is disordered. Occasionally no cause can be discovered, and we have to assume that it is due to some affection of the central nervous system.

Treatment.—When of local origin, the treatment of neuralgia of the testis must be directed to the removal of the cause; and if all other methods fail, and the pain be severe enough to warrant it, castration may be required. When due to affections of other parts of the body, the treatment must be regulated accordingly.

Hyperæsthesia of the gland usually yields in time to tonics, and attention to ordinary hygienic conditions. Jeremiah McCarthy.

**TETANUS.**—Synon.: Lock-jaw; Fr. *Tétanos*; Ger. *Starrkrampf.*

Pathology and Ætiology.—Our knowledge regarding the pathology of tetanus is very limited, but the symptoms which characterise this affection are undoubtedly referable to an abnormal influence of the nervous centres which control the action of the voluntary muscles. Dr. C. Allbutt and other observers have described the pathological changes in the spinal cord, after death from tetanus, to consist of intense congestion of the tissues, with structureless exudations, especially in the grey matter; it is difficult to determine, however, whether these changes are the causes, or simply the effects, of the abnormal nerve-action which characterises tetanus. Most of us have formed some conception of the nature of this disease, from the analogy which exists between the effects of poisonous doses of strychnia and the spasms of tetanus; but we have no grounds whatever for supposing that the *modus operandi* of nux vomica on the nervous system is the same as the cause, whatever it may be, which induces tetanus. On the other hand, there is much in the phenomena presented by some instances of traumatic tetanus, to lead us to think that the violent contraction of the muscles in this disease is due to irritation set up in the peripheral distribution of a nerve, and that this hyper-action once established is conveyed along the nerve to the spinal cord, exciting by reflex action the muscles near the injured nerve to a state of spasm. The irritation subsequently extends, and so the whole length of the spinal cord becomes implicated, a slight impression on the skin producing general tetanic convulsions. In support of this theory as to the origin of the disease, a few cases have been recorded in which division of the principal nerve, or in other instances the stretching of a nerve leading from a wound, has completely stopped an attack of tetanus. And in some cases the writer has certainly seen tetanic spasms commence as if by reflex action; for instance, after tying a large bleeding pile, the patient, within thirty-six hours of the operation, complained of spasms of the sphincter ani muscle, and although the ligature was instantly removed, nevertheless the disease ran a very rapid and fatal course.

On the other hand, the circumstances of tetanus, when considered in all their bearings, point to some influence at work which is different in its nature from that of ordinary reflex action. It is the exception rather than the rule for the muscles in the neighbourhood of the wounded part to be first involved in the disease, as they probably would be if it arose from a purely reflex action; it matters not where the seat of the injury may be, in by far the greater number of cases the muscles of the face are affected before those of any other part of the body. In numerous instances of tetanus the writer has noticed, for twenty-four or forty-eight hours before spasms of the muscles have set in, that the patient's face has presented a pinched appearance, which is very characteristic of the disease, depending on rigidity of the muscles of expression. Various groups of muscles are subsequently involved, in the following order—those of mastication, the neck and back, the muscles of respiration, and lastly, those of the extremities. So generally is this the order in which the muscles are implicated, that the writer is disposed to think that, whatever the pathology of the disease may be, the morbid influence which produces it commences in the medulla oblongata, and extends to the spinal cord. Lastly, the writer has met with many severe cases of tetanus among persons in whom it was impossible to discover any wound or abrasion of the skin or mucous membranes of the body,[1] and in in-

[1] In the surgical wards of the Mayo Hospital, Calcutta, within a period of five years, 83 cases of tetanus were treated. Of these, 44 cases were traumatic, and 24 died. Of the remaining 39 idiopathic cases, 10 died.

stances of this description it is difficult to account for the symptoms of the disease on the theory that it depends on reflex action.

It seems very certain that local circumstances and meteorological conditions greatly influence the occurrence of tetanus. In the tropics, the disease is far more frequently met with than in other parts of the world. It is seldom absent from the Calcutta Hospitals, and in some seasons appears to prevail as an epidemic. It is, in fact, a matter of common observation in Bengal, that after sudden changes of temperature cases of tetanus appear among surgical patients; so that, while admitting that in many instances of tetanus wounds are the immediate cause of the disease, we cannot overlook the fact that a chill is frequently an immediate antecedent. The disease attacks persons of all ages; it occurs occasionally among infants immediately after birth, but more commonly commences a few days after the remains of the umbilical cord have separated from the child's body. Men are more subject to tetanus than women. In the tropics the disease is by no means uncommonly seen among horses, especially after they have undergone the operation of castration.

Symptoms.—Tetanus almost invariably commences, in man or the lower animals, whether it is of traumatic origin or otherwise, in rigidity of the muscles of expression. In the course of a few hours the muscles of mastication and of the head, neck, and back become involved, so that the patient experiences difficulty in opening his mouth, or in moving his head from side to side; and deglutition is impeded by spasmodic contraction of the pharynx. The rigidity of one or more of the groups of muscles above referred to is constant throughout the whole course of the disease; but in addition to this, from time to time these muscles are thrown into the most frightful spasms; in this way the patient's body is sometimes bent like a bow, the whole weight of the trunk being supported on the back of his head and heels. The abdominal and thoracic muscles are also implicated, and hence the patient's belly is tense and hard, and the walls of his chest expand imperfectly in the effort of breathing. The muscles of the arms and legs are often extremely rigid, and convulsed in a most violent manner; they are the seat of terrible pain. The interval between the paroxysms of spasm of the affected muscles is very uncertain; sometimes the cramps last only for a few seconds, at other times for five and even ten minutes. The most dangerous cases of tetanus are evidently those in which the muscles of respiration are principally involved, for death is generally caused in this disease by the interference with the respiratory process, the chest being, as it were, compressed in a vice (Watson). In consequence of the condition of the muscles of the neck and thorax, the sick person is unable to speak, but his intellect generally remains clear up to the last, nor are the other functions of his body materially deranged. The patient suffers much from hunger and thirst, which he is unable to alleviate; and, above all, he longs for sleep, which is frequently denied him in consequence of the recurring spasms. The surface of the skin is bedewed with perspiration; and the pulse rises and falls with the intensity of the spasms, and the duration of the disease.

Course and Duration.—Tetanus is one of those maladies which run a definite course, although its duration is not so precisely defined as that of some other diseases; in some cases it may kill the person affected in the course of a few hours, but in the greater number of instances patients die of tetanus from the seventh to the eleventh day after the commencement of the disease. If they survive the twelfth day, the malady, as a rule, gradually subsides; and the patient may usually be pronounced cured in twenty-five days from the commencement of the attack; but he often suffers for many weeks subsequently from rigidity of the muscles which have been involved in the tetanic spasms.

Prognosis.—The writer has for some time past relied much on the thermometer, not only as a means of forming a prognosis, but as indicating to some extent the treatment to be followed in tetanus. Doubtless in some of the worst instances of this disease the thermometer fails us; for if the muscles of respiration are very much affected, as they are in the most severe cases, the process of combustion within the body is so much interfered with that its temperature is not kept up to the degree it should be, in proportion to the violence of the muscular action. Nevertheless, as a general rule, in instances of tetanus, so long as the thermometer indicates that the temperature of the patient's body is under 101° Fahr., we may remain easy regarding the issue of the case. If the mercury rises in the instrument beyond 101°, there is impending danger; and if it reaches 103°, the case is one to cause us the greatest anxiety. After death from this disease the writer has found the temperature of the body to rise as high as 107°.

Treatment.—One of the most remarkable facts connected with tetanus is the almost incredible amount of Indian hemp and opium which persons suffering from it will swallow, without producing their poisonous effects on the system. The writer has prescribed these drugs in very large doses, but has failed to satisfy himself that they influence for good the progress of the malady. He has also given the Calabar bean a fair trial in tetanus; but unless it be pushed to the extent of rendering the patient collapsed, the temperature of his body falling perhaps to 94° or 95°, and the pulse being hardly perceptible at the wrist, he has found that this medicine hardly affects the spasms of tetanus in severe cases, whilst in the milder forms of the disease there is no necessity for resorting to such a dangerous means of cure. In fact, we know of no system of treatment which will cut short the progress of a case of tetanus, and, therefore, the indication is to employ all our efforts to keep the sick person alive during the illness through which he is passing. As means to this most desirable end, we must feed him, and, if possible, secure him at least some eight hours' sleep during the day. With respect to food, the patient must be made to swallow about four ounces of milk every four hours; one egg, or half an ounce of the juice of raw meat, being mixed with the milk, morning, noon, and evening. If the pulse indicates great exhaustion, beef-tea and brandy

may be given as an enema, in addition to the above-mentioned food. In cases of tetanus the teeth are often so firmly locked together that it is necessary to insert one's fingers between the closed jaws and the cheeks, and pour the milk into the cavity thus formed; the liquid will trickle between and behind the patient's teeth, and pass down his throat. Some of it may occasionally run into the trachea, and cause considerable spasm, but the writer has never seen any more serious result follow from this. If the patient can swallow with comparative ease, arrowroot may be mixed with the milk; a man can live very well on a diet of this description for some twenty-five days.

With reference to drugs, the writer knows of no medicine which procures sleep so well as the hydrate of chloral in cases of tetanus. It should be administered in 40-grain doses (to an adult) at bedtime; and in severe cases of the disease (the temperature of the patient's body rising to upwards of 101°) an additional 30 grains of chloral should be given at mid-day. However serious the case may seem to be, we should rigidly adhere to the plan of treatment above described, the urgency of the symptoms not causing us to deviate from our attempts to make the patient swallow a sufficiency of food, and of the hydrate of chloral, to enable him to struggle through the malady from which he is suffering.

C. Macnamara.

**TETANY.**—Synon.: *Tetanilla*; Idiopathic muscular spasm; Fr. *Tétanos intermittent.*

Tetany is a neurosis originally described by Dance in 1831, and more or less fully described since under many names, especially in France. It is probably much more common in that country than in England, where it is very rarely met with. It is mostly a comparatively trivial and temporary malady.

Ætiology.—The disease is associated with no recognised organic changes in any part of the nervous system, and much uncertainty prevails in regard to its causation. It occurs mostly between the ages of 15 and 30 years, though it may show itself in older people, as well as in young children, and even in infants. It occurs in either sex, but is more common among females. Persons of a neurotic temperament, or those whose constitutions have been disturbed or weakened from many causes, are specially liable. Teething, the establishment of menstruation, chronic diarrhœa, lactation, the state of convalescence from many acute diseases, are all conditions which predispose to this affection; whilst exposure to cold, and emotional disturbance seem to act as the most common exciting causes.

Symptoms.—The morbid manifestations consist, in the main, of tonic spasms, frequently recurring for brief periods in one or other part of the body, painful in character, and unaccompanied by loss of consciousness. The attacks in different individuals vary widely, the spasms being sometimes quite local, and sometimes involving many different regions of the body.

In the *slighter kinds* of attack, a numbness and tingling is felt in the fingers and toes, which speedily become fixed in tonic spasm. As the spasms strengthen, they may extend to higher parts of the limb, and become painful. The fingers are drawn together and slightly flexed, the thumb is bent into the palm, and the wrist slightly flexed. The toes also are drawn together and towards the sole, the big toe being drawn under them. The dorsum of the foot is arched and the heel pulled up, whilst the leg and thigh are more or less rigidly extended. One or more of the limbs may be affected in this way, or if all are implicated, it may be simultaneously or successively. This condition of things lasts for a few minutes, or even for an hour or two, accompanied often by severe pain along the nerve-trunks, and by some diminution of sensibility in the parts affected. When the attack is about to terminate formication sets in, as at the commencement of the spasm. After variable intervals the attacks are renewed, it may be in an hour or two, or only after several days. Such paroxysms may be frequent during several months; and, according to Trousseau, so long as a tendency to recurrence of the spasms exists, they may always be excited anew by simply 'compressing the affected parts, either in the direction of their principal nerve-trunks, or over their blood-vessels, so as to impede the venous or arterial circulation.' On the other hand, the application of cold to the parts affected frequently arrests the spasms for a time.

In the *more severe forms* of tetany, the attacks may begin in the way above indicated in the upper extremities, next in the lower extremities, and then, whilst diminishing in the parts first affected, they may extend more or less generally to the trunk muscles. The contractions are invariably more or less painful. The spasms may even spread to the facial muscles, so that the jaws may be firmly clenched, and speech greatly embarrassed. If the muscles of the larynx are involved, as well as those of the chest and abdomen, extreme dyspnœa may be induced. Still there is no loss of consciousness. These attacks may be of brief duration; or they may be extreme in degree, long-continued, and frequently repeated. In such severe cases there is slight elevation of temperature, with greatly quickened pulse, and a furred tongue. After some weeks or months the paroxysms usually become less severe, less frequent, and finally cease altogether.

Diagnosis.—The diagnosis must be based upon the progressive character of the attacks; upon the fact that they begin in the upper and lower extremities, and after a time completely intermit; upon the absence of all loss of consciousness during the attack; and upon the fact of the possibility of reinducing the paroxysms by pressure upon the nerves or vessels of the parts affected. These characters will suffice to distinguish the affection from tetanus, epilepsy, and hysteria.

Prognosis.—The prognosis is usually favourable, the complaint gradually subsiding after a few months. Still, in very exceptional cases, the patient may die asphyxiated during one of the extremely severe attacks.

Treatment.—The treatment of tetany should in the main be directed to the improvement of the patient's general health, and the diminution of all debilitating conditions or causes of irri-

tation. At the same time, we must endeavour to lessen the general mobility of the nervous system, by seeing that the patient obtains regular and sound sleep, as well as by the administration of the bromides in suitable doses, in combination with valerian, musk, conium, or other antispasmodic remedies.

H. Charlton Bastian.

**TETRASTOMA RENALE** (*τέτρα*, fourfold; *στόμα*, a mouth; and *ren*, a kidney).—A form of entozoon found on one occasion in the urine of a patient by Lucarelli, and described by Delle Chiaje. See *Entozoa*, by Dr. Cobbold, Lond., 1864.

**TETTER.**—Tetter is an old Saxon word, equivalent to the French *dartre*. Tetter is defined to be 'a tickling and itching scab,' and may be taken to signify a chronic inflammation of the skin, attended with desquamation and itching. In this sense the term is popularly applied to patches of chronic eczema, and especially to those of psoriasis; but it is altogether too indefinite in its meaning for scientific use.

Erasmus Wilson.

**THALAMUS OPTICUS, Lesions of.**—Synon.: Fr. *Maladies des Conches optiques*; Ger. *Krankheiten der Sehhügel.*

Introduction.—Diseases of the optic thalamus vary in their symptomatology according as the lesion is strictly limited to the ganglion itself, or implicates also neighbouring structures.

In the former case it is apparently well established, by numerous recorded cases, that lesions, such as apoplectic cysts, or areas of softening, may exist without producing any discoverable symptoms, either in the domain of motility or sensibility, general or special. This is more particularly the case when the lesions occupy the convexity or ventricular aspect of the optic thalamus.

But more frequently diseases affecting the optic thalamus implicate also, directly or indirectly, the corpus striatum, internal capsule, crus cerebri, or corpora quadrigemina. Owing to the community of vascular supply between the corpus striatum and optic thalamus through the opto-striate arteries of Duret, embolism or rupture of these vessels leads to conjoint destruction, more or less extensive, of both ganglia, as well as rupture, or pressure on the fibres of the internal capsule. A hæmorrhage or embolism in this region produces hemiplegia of the opposite side of the body. But that the hemiplegia cannot be due to the lesion of the optic thalamus is clear from the fact that such lesions may exist without any motor paralysis whatever. It is, therefore, more logical to attribute motor paralysis, when it does occur in connection with lesions of the optic thalamus, to implication, direct or indirect, of the corpus striatum or the motor fibres of the internal capsule.

Localizing Phenomena.—It is a question whether, apart from considerations as to causation, there are any symptoms specially characteristic of hæmorrhages in the region of the optic thalamus.

Among other symptoms noted are clonic or tonic spasms of the paralysed limbs in a considerable number of the cases. These, however, though, according to Bastian, occurring in about three-fourths of the cases, cannot be regarded as pathognomonic, for similar spasms may occur from lesions elsewhere, as in the cortex, centrum ovale, and pons.

Nor is it true that lesions of the optic thalamus specially cause paralysis of the upper extremity, as has been contended by Saucerotte and others. The leg may suffer quite as much; and indeed when the motor paralysis is associated with anæsthesia, the affection of the leg is frequently much more pronounced than that of the arm or face.

The occurrence of anæsthesia on the paralysed side is more constant and more enduring when the lesion invades the optic thalamus and its neighbourhood, than when it is confined to the ganglia of the corpus striatum. This is owing to the fact that the posterior fibres of the internal capsule are directly injured, and not merely pressed on, as in the latter case. The anæsthesia may extend to the special senses as well as common sensibility, but more frequently the tactile sensibility only is distinctly impaired. The reflex cutaneous excitability is also greatly diminished, as has been shown by Crichton Browne (*West Riding Asylum Reports*, vol v.). The paralysed limbs are frequently also affected with unsteadiness, tremors, or choreic-like spasms, intensified on volitional efforts. This affection, termed *post-hemiplegic chorea* (Weir-Mitchell, Charcot), is generally if not invariably associated with a greater or less degree of impairment of sensibility in the affected limbs. It is doubtful how much, if anything, can be assigned to the lesion of the optic thalamus itself in the causation of these symptoms. But for regional diagnostic purposes, they may be regarded as significant of lesion of the optic thalamus and its immediate neighbourhood. When the lesion involves only the posterior fibres of the external capsule, lying external to the optic thalamus, the result is hemianæsthesia, general and special, of the opposite side of the body. The power of movement may not be apparently affected. If so the leg is, in general, relatively more affected than the arm. But, though the motility is retained, the muscular sense is lost, so that the patient is unaware of the state of contraction of the muscles or the position of the limb, and requires the aid of vision in guiding its movements.

Cases have been recorded by Hughlings Jackson and others, which render it in the highest degree probable that lesions of the posterior aspect of the optic thalamus, and region of the corpora geniculata, cause hemiopia towards the side opposite the lesion, from paralysis of both retinæ on the corresponding side. A similar result ensues from direct lesion of the optic tract, however, and also from severance of the medullary fibres of the occipito-angular region. Hence hemiopia alone, without other symptoms, cannot be taken as absolutely diagnostic of lesion of the posterior aspect of the optic thalamus. Conjoined with affection of the other forms of sensibility, however, it points to lesion in this region.

Tumours of the optic thalamus, in addition to the general symptoms of intracranial growths, though sometimes these even seem to have been wanting, produce either no special symptoms, or such a variety as to render the regional diagnosis very uncertain or altogether impossible. The symptoms may be those indicative of lesion of the internal capsule, both its motor and sensory strands; or they may be such as have been observed in connection with lesions of the corpora quadrigemina.

It will thus be seen that, in respect to the regional diagnosis of diseases of the optic thalamus, we are obliged to rely on a combination of symptoms, not one of which can be regarded as absolutely depending on the optic thalamus itself, and our localisation is at best only approximate.

Treatment.—The treatment of diseases of the optic thalamus comes under the head of treatment of cerebral disease in general.

D. Ferrier.

**THERAPEUTICS** (θεραπεύω, I attend.—Synon.: Fr. *Thérapeutique*; Ger. *Therapie*.

Definition.—The science and art of healing.

Introduction.—Therapeutics is the most essential part of medicine, for although other parts of medical science are interesting to the practitioner, it is the cure of disease which the patient seeks. Therapeutics may be divided into two classes—the therapeutics of fancy, and the therapeutics of fact. In order to cure disease with certainty, the practitioner must know what the nature of the disease is, and what the action of his remedies will be. When these are positively known, therapeutics becomes a science, but when either is uncertain, it is simply an art. Its principles may hereafter become a science, but its practice must always remain more or less an art, and be dependent for success upon the skill of individuals. For the symptoms which ought to indicate to the practitioner the nature of the disease may be wrongly interpreted by him, or, as it is usually termed, he may form a wrong diagnosis, and thus be led to apply wrong remedies. The idea in the practitioner's mind may correspond more or less exactly with the condition of the patient, or may not have the slightest resemblance to it; and it is only by careful comparison and experiment that their agreement can be ascertained. An absurd fancy of the practitioner will lead to absurd treatment, and the therapeutic results will not be satisfactory.

History.—In all ages of the world's history we have had the therapeutics of fancy and the therapeutics of fact running side by side, and, in proportion as the latter has predominated, has treatment been improved. In primitive times the imagination of physicians was busy with fancies regarding the nature, the causes, and the cure of disease. The nature of the disease was sometimes supposed to consist in the possession of the body by an evil spirit, which caused the morbid symptoms, and the cure consisted of various incantations and exorcisms. At other times the disease was supposed to consist in alterations of the fluids or of the solids of the body, or of the formative principle which pervaded them. It was supposed that in disease the juices left their proper places in the body, or became disproportioned in quantity, or that the atoms and pores of the solids became altered, so as no longer to allow of free atomic motion. At other times, again, morbid conditions were attributed to fermentation, with production of alkalies or acids in the body; and later on, when the contractile power of muscular fibre was recognised, diseases were supposed to be due to spasm or atony. Equally fanciful qualities were attributed to medicines, some being reckoned hot, some cold, some astringent, some opening and some closing the pores, some contracting and some relaxing the muscular fibres, and some being supposed to cure disease because there was some external resemblance between them and the organ of the body affected.



Principles.—The unsatisfactory results of such fanciful therapeutics have led some, in all ages of medicine, to a more or less *experimental* therapeutics. Physicians saw men suffering and dying all around them, and could not wait for exact knowledge. They therefore applied themselves to tentative therapeutics, giving first one thing and then another in the hope of doing good, and collecting the results of these experiments on their patients, for the guidance of themselves and others in subsequent cases. The results thus obtained, showing that a certain drug was useful in a certain disease without the reason of this utility being known, constituted *empirical* therapeutics. In order to obtain a broader basis than that afforded by the observation of any single man, some have collected numbers of cases from various observers, and have analysed and tabulated them. The results of this method constitute *statistical* therapeutics. But it is liable to great fallacies, inasmuch as cases which are very different are tabulated, for convenience' sake, under the same name, and the results are, therefore, rendered untrustworthy.

The problem placed before the practitioner in the treatment of any one case is rendered exceedingly difficult, not only by reason of the complexity of the bodily mechanism itself, but by the manifold alterations to which it is subject in disease, and the variations produced in the action of a drug by alterations in dose, by differences in the original constitution of the patient, and further differences superinduced by the disease. So complex, indeed, is the problem, that it is impossible to unravel it by any number of observations in disease, and it can only be solved by making ourselves acquainted with a few of the conditions at a time. This can only be done by experiment upon animals, for human life is too valuable to allow of the necessary sacrifice. By experimental physiology, the functions of the various parts of the body and their relations to each other are being gradually ascertained; in experimental pathology diseases are induced artificially, in order that we may discover the alterations produced by them in the functions; and in experimental pharmacology, drugs are administered in order to determine the part of the body which they affect, and the nature of the alterations which they produce in its function. The problem being thus simplified,

the practitioner may hope to recognise, from the symptoms of the patient, the organ affected by disease, the nature of the disturbance in its function, and to apply with some degree of success a remedy which will counteract such disturbance. This constitutes *rational* therapeutics. Great advances have of late years been made in this direction, but it will be a long time yet before we can hope to attain such exact knowledge as we desire, and at present our therapeutics must be to a certain extent empirical. When directed towards the removal of the cause of the disease it has been called *pathogenetic* therapeutics. When this cannot be recognised, or cannot be removed, the treatment is directed to those parts of the organism on which the cause of disease acts, so as to lessen or remove the symptoms which it would otherwise produce. This is *symptomatic* therapeutics. And when we can neither remove the cause nor relieve the symptoms, but are forced to trust to the *vis medicatrix naturæ*, and try to maintain the patient's strength by food and nursing, we have *expectant* treatment. This might perhaps also be called expectant therapeutics, for although in its narrowest sense we generally understand by this term cure by means of medicines, in its wider acceptation it includes nursing, climate, and measures of treatment, such as regulated exercise, regulated gymnastics, friction, massage, the application of heat, and cold water. T. Lauder Brunton.

**THERMOMETER, Clinical** (*θέρμη*, heat, and *μέτρον*, a measure).—Synon.: Fr. *Thermomètre*; Ger. *Thermometer*.

Definition.—An instrument for measuring different degrees of heat or cold.

Description.—The thermometer was invented by Galilei, about 1603, but it was Sanctorius (1561–1636) who first had the idea of investigating the temperature of the human body in health and disease. The substances made use of in the construction of thermometers are mercury, first used by Fahrenheit; a coloured fluid—such as alcohol; or air. Any of these substances, enclosed in a fine exhausted glass tube, expanding at one end into a globular or cylindrical bulb, represents a thermometer. On applying heat or cold to the bulb the contents expand and rise, or contract and descend in the tube. The extent of the rise or fall can be expressed in a number of a scale, which is engraved on the stem or on a separate piece of white glass, or on a strip of paper fixed to the stem, and enclosed with it in a wider glass tube.

The thermometers used in this country and in the United States are graduated with *Fahrenheit's* scale, whereas on the Continent of Europe the *Centigrade* or *Celsius* scale is now everywhere used for medical and scientific purposes, the *Réaumur* scale falling more and more out of use. The difference between these three scales is this, that in the centigrade and Réaumur scales the melting-point of ice is marked zero, and the boiling-point of water (or rather the heat of the steam of water boiling at an atmospheric pressure equal to 29·92 inches of mercury) marked 100° and 80°, respectively; whilst *Fahrenheit* marked the former by 32° and the latter by 212°; 180 degrees of the Fahrenheit scale are, therefore, equal to 100° centigrade and 80° Réaumur, and the relation of the three scales to each other is, therefore, as

| F. | | C. | | R. |
|---|---|---|---|---|
| 9 | : | 5 | : | 4 |

One degree of F. = $\frac{5}{9}$ C. or $\frac{4}{9}$ R.; one degree C. = $\frac{9}{5}$ F.

In converting degrees of the Fahrenheit scale into centigrade degrees, it must, however, be borne in mind that zero of the C. scale corresponds to 32 of the F. scale; 32 must, therefore, be deducted in converting a certain degree of the F. scale into the corresponding degree of the C. scale, and 32 must be added when C. degrees are to be expressed by the corresponding degrees of F. The formulæ for these conversions are, therefore:—

$$x \text{ deg. F.} = (x - 32) \times \tfrac{5}{9} \text{ deg. C.}$$
$$x \text{ deg. C.} = (x \times \tfrac{9}{5}) + 32 \text{ deg. F.}$$

For instance:

$$99{\cdot}5 \text{ F.} = (99{\cdot}5 - 32) \times \tfrac{5}{9} = 67{\cdot}5 \times \tfrac{5}{9} = 37{\cdot}5 \text{ C.}$$
$$39 \text{ C.} = (39 \times \tfrac{9}{5}) + 32 = 70{\cdot}2 + 32 = 102{\cdot}2 \text{ F.}$$

It will be convenient, for quick reference, to give the corresponding degrees of the Fahrenheit and centigrade scales in that range with which human physiology and pathology are concerned, side by side:—

| Fahr. | Cent. | Fahr. | Cent. |
|---|---|---|---|
| 95·0 | 35·0 | 104·0 | 40·0 |
| 96·0 | 35·55 | 104·9 | 40·5 |
| 96·8 | 36·0 | 105·0 | 40·55 |
| 97·0 | 36·11 | 105·8 | 41·0 |
| 98·0 | 36·66 | 106·0 | 41·11 |
| 98·6 | 37·0 | 106·7 | 41·5 |
| 99·0 | 37·22 | 107·0 | 41·66 |
| 99·5 | 37·5 | 107·6 | 42·0 |
| 100·0 | 37·77 | 108·0 | 42·22 |
| 100·4 | 38·0 | 108·5 | 42·5 |
| 101·0 | 38·33 | 109·0 | 42·77 |
| 101·3 | 38·5 | 109·4 | 43·0 |
| 102·0 | 38·88 | 110·0 | 43·33 |
| 102·2 | 39·0 | 111·2 | 44·0 |
| 103·0 | 39·44 | 112·1 | 44·5 |
| 103·1 | 39·5 | 113·0 | 45·0 |

In thermometers for clinical use the degrees on the scale ought to be divided into fifths. Thermometers ought to be carefully compared from time to time with a standard thermometer, as they are liable, after a certain time, to give abnormally high indications, owing to the bulb gradually contracting a little. In England they may be sent for comparison to the Kew Observatory.

Of great convenience for clinical use has been the introduction of self-registering mercurial maximum thermometers. It is not without interest to notice that a self-registering thermometer by a small piece of iron being introduced into the tube, had been used by Currie, at the end of the last century; but just as Currie and de Haën's work with the thermometer had been entirely forgotten for half a century, so were self-registering thermometers only used again in medicine some time after the ordinary thermometer had been re-introduced into clinical practice by Baerensprung, Traube, and Wunder-

lich. Casella was the first who constructed a registering clinical thermometer, by introducing a small quantity of air into the tube, and thereby separating a small part of the mercurial column from the rest. Instruments are now made in which the index—that is, the small separated part of the mercurial column—is prevented from falling back into the bulb, or in which an index is only formed each time the mercury rises out of the bulb. In using an instrument of this kind, the index, it need hardly be said, must be shaken down below 95° or 90° before the thermometer is applied to the patient.

Another principle has been followed in the construction of very sensitive instruments for special researches on temperature, namely, that of the thermo-electric apparatus. The electric current, which is produced in a circuit composed of two different metals, when their point of contact assumes a different temperature from that of the other ends, or again the changes which a galvanic current shows when the resistance of a part of the circuit is altered by a change of temperature acting on it, can be measured by a galvanometer inclosed in the circuit. Gavarret, Heidenhain, and other physiologists have used the thermo-electric pile in physiological investigations in animals. J. S. Lombard and Hankel have applied it to observations in man. Quite recently a convenient form of thermo-electric apparatus for clinical purposes has been devised by Rédard. The apparatus constructed, on the last-mentioned principle, by C. W. Siemens, for measuring deep-sea temperatures, might also easily be adapted for clinical purposes.

A self-registering apparatus for continuous observations, on the principle of an air-thermometer, has been constructed by Marey; and it would seem as if the desideratum of a clinical thermograph, automatically registering the changes of temperature on the surface of the body during a certain time, were near being satisfactorily realised in the instrument brought out by Mr. W. D. Bowkett (*Lancet*, July 1881).

For measuring surface-temperatures, mercurial thermometers of special shape, namely, a long cylindrical bulb coiled up in one plane at a right angle to the stem, have also been constructed. A thermo-electrical apparatus, or Bowkett's instrument, is however more sensitive and more convenient for that purpose.

**Applications of the Thermometer.**—The object we generally have in view with clinical thermometry being to examine as nearly as possible the temperature in the interior of the body, or the blood-heat, which is less variable than that of the surface (*see* TEMPERATURE), the localities most suitable for applying the thermometer would be the natural cavities, or the openings by which a thermometer might be introduced to a certain depth into the interior of the body. In the rectum, vagina, or bladder, the temperature is not subject to the ordinary changes acting from without, and the time required for taking an observation with the thermometer in any of these localities, would be only such as is necessary for raising the temperature of the mercury to that of the surrounding mucous membrane. This time might be materially shortened by previously heating the thermometer to a degree a little below that to be expected in the body. With this precaution an observation of the temperature in the rectum or vagina will not take more than half a minute.

The case is very different if we take the temperature in a cavity of the body which is not always closed, such as the mouth; or in the axilla, which can be formed into a closed cavity only by placing the arm closely against the chest. Here the time required for an observation is much longer, because the temperature of the mucous membrane of the mouth, or of the skin of the axilla, begins itself slowly rising after the closing of these cavities, until it is raised to that of the deeper tissues which are not exposed to the loss of heat from without. Whereas nine to eleven minutes on an average are required for an observation of the temperature in the mouth, ten to twenty-four may be necessary for the mercury to become stationary in the axilla. The time varies also according to the state of the general circulation. It will be found much longer in persons with a weak circulation, for instance, in a case of heart-disease, than in the case of a vigorous patient with a good circulation and with febrile heat. It is evident that, as was first pointed out by Liebermeister, the time for an observation in the mouth or axilla can be materially shortened, not so much by previously heating the thermometer, as by, previously to the introduction of the latter, keeping the mouth or axilla closed for ten to fifteen minutes. These cavities will then have assumed a steady temperature, and the time required for the observation will only be that necessary for raising the temperature of the mercury and the glass to the temperature of the surrounding parts. It is, therefore, a good plan if the patient had been lying on one side to turn him over to the other, or to make him lie on one side for a time before the thermometer is introduced, and then to put it into that axilla which had been closed by the position of the patient. If the skin of the axilla be very wet with perspiration, it ought to be wiped dry before applying the thermometer.

For practical purposes the rule generally recommended in observations being taken in the axilla, to leave the thermometer until the mercury has remained stationary for five minutes—a rule which naturally applies to self-registering no less than to ordinary thermometers—secures sufficient accuracy, and this rule should be given to nurses and attendants to whom the observations are left. Especially in obscure cases, in which much depends upon the discovery of even a trifling elevation of the temperature above the normal standard, which may be of great importance for diagnosis, this precaution ought never to be omitted; and for observations requiring scientific accuracy, as, for instance, when the effect of some drug on the temperature of the body is being studied, the observations ought to be made by the physician himself.

For various reasons the axilla is the locality most suitable, and, therefore, generally used for thermometrical observations. In very young or restless children, however, as well as in very emaciated adults, axillary observations would become untrustworthy. In such cases, or where patients

are in an insensible state, or under special circumstances—for instance, when a great divergence exists between the axillary and the internal temperature, or when doubts arise as to the correctness of an axillary observation—the rectum, or eventually the vagina, may be used for applying the thermometer, and with a self-registering thermometer this can be done without unnecessarily uncovering the patient. In using the rectum, great care must be taken not to let a small instrument slip into it, and in restless children to prevent the instrument from being broken. This is best prevented by placing the patient on his side, and while the thermometer is kept *in situ* with one hand, letting the other one rest on the hip of the patient, in order to be able at once to arrest any turning movement which he might happen to make. The thermometer ought to be introduced about two inches deep into the rectum; and may, before being taken out, be gently pushed forward a little more, in order to bring the mercury in contact with a fresh part of the mucous membrane, which has not been cooled by the bulb of the thermometer. When large masses of fæces fill the rectum, the thermometer passing into them may indicate a somewhat lower temperature than when in contact with the mucous membrane.

Other places of application, such as the inguinal fold, or the fold of skin between the thumb and the second metacarpus, may be used for special, but are quite unsuitable for general, clinical purposes. For observations made with the thermometer *see* TEMPERATURE.

**Thermometrical Records.**—It is extremely useful to register the thermometrical observations in a case of disease on a chart, and to connect the marks by lines; the curves which are thus formed being quite typical in many diseases. On the same chart may be entered, also by marks and lines, or otherwise, the numbers of the pulse and respirations, as well as remarks concerning other symptoms, or the treatment.

The use of the thermometer for estimating the temperature of rooms, and especially of wards, is fully described in other appropriate articles. *See* NURSING; and PERSONAL HEALTH.

C. G. H. BÄUMLER.

**THIRD NERVE, Diseases of.**—The third nerve is purely motor in function and supplies the levator palpebræ superioris, the superior inferior and internal recti, the inferior oblique, the ciliary muscle, and the sphincter of the iris. It arises from the surface of the crus cerebri by a series of fasciculi, which pass to a nucleus of grey matter lying on the posterior portion of the floor of the third ventricle and beneath the aqueduct of Sylvius. The anterior part of the nucleus in the floor of the third ventricle innervates the ciliary muscle; the middle part, beneath the anterior extremity of the aqueduct of Sylvius, supplies the sphincter of the iris; and the posterior part of the nucleus innervates the extrinsic muscles of the eyeball (Hensen and Vœlckers).

Morbid states of the third nerve show themselves as spasm or paralysis in the muscles supplied by it, that is, of the eyeball, the upper eyelid, the iris, and in the ciliary muscle.

1. **Spasm.**—Spasm is never met with at the same time in all the muscles supplied by the third nerve. It occurs in isolated ocular muscles, especially in the internal rectus, in conditions of irritation of the trunk and nucleus of the nerve, as in meningitis, in hysteria, also in hypermetropia, and in paralysis of the antagonist muscle. When extreme the eyeball is turned inwards, and cannot be moved out. Clonic spasm of the muscles occurs in 'nystagmus.' The elevator of the upper eyelid is occasionally spasmodically contracted, so that the eye cannot be shut, but remains widely or partly open (lagophthalmos). Slight contraction of this muscle occurs in cases of long-continued paralysis of the orbicularis palpebrarum. Spasm of the muscle is chiefly due to reflex causes, especially to neuralgia of the fifth nerve.

Spasm of the sphincter of the iris produces contraction of the pupil, sometimes to very small dimensions (myosis). It may be a congenital condition, but also results from irritation of the trunk of the third nerve; from stimulation, central or reflex, of the nucleus; or it is secondary to paralysis of the dilator fibres supplied by the sympathetic. It may result from excessive (associated) efforts at accommodation. It is, however, most frequently met with in locomotor ataxy, and is associated with loss of reflex action. The condition is described more fully in the next section. Spasm of the ciliary muscle may result from the other causes of irritation of the nerve-trunk, or from excessive efforts at accommodation in hypermetropia. Its effect is to produce a fixed accommodation for near objects.

TREATMENT.—The treatment of the central causes of overaction of the third nerve commonly resolves itself into that of the primary condition. Where no cause is obvious, rest is most important, and efforts at accommodation should cease; tonics and counter-irritation, and sometimes injections of morphia, may be employed. Atropia will overcome spasm of the sphincter pupillæ or of the ciliary muscle. The cold douche to the eyeball is useful in spasmodic lagophthalmos.

2. **Paralysis.**—ÆTIOLOGY.—The commonest cause of paralysis of the third nerve is some affection of its trunk in its passage through the membranes at the base of the brain, the orbital fissure, or within the orbit; due either to rheumatic inflammation of the nerve-sheath, or to syphilitic inflammation of the nerve or membranes. Less frequent causes are diseases of, or adjacent to, the inner part of the crus cerebri through which the fibres pass and from which they emerge (hæmorrhage or softening of the crus, aneurism or growth in the interpeduncular space), basilar meningitis, and aneurism of the termination of the internal carotid. It is also met with as a result of diphtheria, and in association with disease of the spinal cord, especially locomotor ataxy.

Occasionally all the muscles supplied by the third nerve become paralysed, together with the other orbital muscles—the ophthalmoplegia externa of Hutchinson. In such a case the writer has found a degeneration of the nerve-cells of the nuclei of these nerves.

SYMPTOMS.—Paralysis may affect some or all

the fibres of the third nerve. When complete the upper eyelid is dropped and cannot be raised, and can be moved only outwards, and a little outwards and downwards; after a short time it is always turned outwards. The pupil is in a mid-state between contraction and dilatation, and cannot be made to contract by light; power of accommodation in the eye is lost by paralysis of the ciliary muscle. Each part supplied by the nerve may be paralysed separately, by affection of the special branch of the nerve after it leaves the main trunk. When the levator palpebræ superioris is affected, *ptosis* or dropping of the eyelid alone results. An attempt is made to raise the eyelid by excessive contraction of the corresponding half of the occipito-frontalis. Double ptosis is often seen in elderly persons, without other evidence of nerve-weakness.

In paralysis of one of the three straight muscles supplied by the third nerve, there is strabismus, with defective movement in the direction of action of the affected muscle, and double vision, the distance between the two images increasing as the object is moved in the direction of action of the affected muscle. When the internal rectus is paralysed, slight power of movement inwards still remains from the superior and inferior recti. There is divergent strabismus and crossed diplopia; when looking upwards and inwards the images approach at the top, when looking downwards and inwards they approach at the bottom. The patient carries his head turned towards the side of the affected muscle, to avoid the double vision. When the superior rectus alone is paralysed, the movement upwards of the affected eye is diminished, and the eye deviates a little outwards; there is crossed diplopia in the upper half of the visual field, the image formed by the affected eye being higher than the other, the two diverging above, the difference in height being greater in looking outwards and upwards, while the difference in obliquity is greater on looking inwards and upwards. When the inferior rectus only is affected there is defective movement, with crossed diplopia, on looking downwards. The second image is below that of the healthy eye, the distance between them being greatest on looking downwards and a little inwards. The images are not parallel, but diverge at the bottom, and the difference in obliquity increases on looking inwards and downwards. The inferior oblique is very rarely affected alone.

In paralysis of the sphincter pupillæ the elasticity of the structure maintains the pupil at middle size, and it can be further dilated by atropia, but all power of contraction beyond the middle size is lost. When the ciliary muscle is paralysed, the power of accommodation is lost, the far point of vision remains the same, but the near point is rendered much more distant.

The remarkable loss of reflex action of the iris which occurs in association with locomotor ataxy is usually accompanied by myosis. Not only does the pupil not contract on exposure to light, but, if small, it does not dilate on stimulation of the skin (Erb). The associated contraction on accommodation is usually preserved (Argyll-Robertson). Sometimes this is lost, and the ciliary muscle is also paralysed—the ophthalmoplegia interna of Hutchinson. These symptoms may also occur in cases of old syphilis, apart from spinal disease. They probably depend on localised degeneration in the nuclei of the third nerve.

Diagnosis.—Paralysis of the third nerve is generally obvious: it is only the slighter paralyses of separate branches supplying the ocular muscles which are sometimes not easy to recognise; and, for this purpose, a careful examination of the double images is often necessary. The diagnosis of the cause is less easy. Rheumatic paralysis succeeds exposure to cold, and is often attended by much pain; in syphilis other cranial nerves are often affected independently; in meningeal and spinal disease there are the respective distinctive symptoms; in disease of the crus there is hemiplegia of the opposite side, coincident in onset with the affection of the third nerve; in interpeduncular disease the affection of the third nerve may precede the hemiplegia, and both third nerves commonly suffer. After diphtheria the ciliary muscle is usually alone affected.

Prognosis.—When due to cold or to recent syphilitic mischief, or after diphtheria, the prognosis is good if proper treatment can be secured. In cases of organic cerebral disease it is less favourable, and is subordinated to that of its cause. In association with spinal disease the ultimate prognosis is unfavourable, for, although the early attacks are usually recovered from, the affection commonly recurs.

Treatment.—In rheumatic paralysis from cold, hot fomentations, counter-irritation by blisters to the temple, small doses of iodide of potassium, and tonics are the most useful. When of syphilitic origin large doses of iodide of potassium usually suffice to effect a cure. If associated with spinal mischief, strychnia, iron, and arsenic are occasionally of some service. In intracranial disease—tumour, aneurism, or meningitis—the treatment is that of its cause. After diphtheria tonics are alone necessary. In paralysis of the sphincter pupillæ and ciliary muscle, occasional instillation of a small quantity of Calabar bean, by stimulating locally the paralysed fibres, does good, and has been said to be beneficial in affections of other branches of the nerve. In the paralysis of the ocular muscles electricity is sometimes of use, applied through the eyelid to the affected muscle, small electrodes being used, and the eye so turned as to bring the muscle as much as possible within reach. One electrode may be placed on the muscle, the other on some indifferent part or on the temple, or both electrodes may be placed over the muscle. The voltaic current slowly interrupted is the more useful; the negative pole should be placed on the muscle, the positive on the temple. Faradisation is of less service; the feeble strength which alone can be used is, so to speak, absorbed by the orbicularis. The application of the continuous current in the neighbourhood of the orbit sometimes produces slight temporary improvement.

W. R. Gowers.

**THIRST.**—Synon.: Fr. *Soif*; Ger. *Durst.*—Thirst is a sensation indicating a necessity on

the part of the system for an increased supply of water, as appetite shows there is a need for the introduction of food. Although the sensation is referred to the back of the throat, it is not a purely local feeling, as is proved by the fact, well-known to physiologists, that it cannot be allayed by the swallowing of water, unless the fluid reach the stomach and be absorbed It is always present in febrile disorders, an increased supply of liquid being required both to reduce the heat, by promoting the evaporation of moisture from the skin and lungs, and also to wash away the products of the increased tissue-changes that accompany these complaints. In like manner it is always present when much fluid has been abstracted from the system; thus, it shows itself after all surgical operations attended by hæmorrhage. It is a prominent symptom in cholera and diarrhœa, in which diseases large quantities of serum are rapidly removed from the gastro-intestinal circulation, and it is equally so in diabetes, where fluid is largely excreted along with sugar by the urinary organs. A craving for cold and acid drinks presents itself in acute gastritis, the intensity of the thirst being perhaps due to the incessant vomiting, which prevents fluids remaining long enough in the stomach to be absorbed. In chronic gastritis thirst is usually present, and is chiefly complained of towards evening. It forms a useful diagnostic sign where there is a difficulty in distinguishing between this disease and mere atonic dyspepsia.

Treatment.—Thirst is relieved by the agents usually recognised as refrigerants, such as water, barley-water, toast and water, and similar drinks; sucking small pieces of ice; effervescing drinks; freely diluted acid drinks, especially those made with vegetable acids or phosphoric acid, alone or combined with a little aromatic bitter; the juices of fruits, or these made into drinks. Care has often to be exercised in the employment of these apparently harmless agents, and their consumption has to be checked, otherwise patients will take them to excess, and may thus do themselves considerable injury.

Samuel Fenwick.

**THORACENTESIS** (θώραξ, the chest, and κεντέω, I prick).—A synonym for paracentesis thoracis, or tapping of the chest. *See* Paracentesis; and Pleura, Diseases of.

**THORACIC ANEURISM.**—Under this head are included aneurisms of (A) the **intra-thoracic aorta**; (B) the **arteria innominata**; (C) the **pulmonary artery**; (D) the **coronary arteries**; and (E) the **heart**. The last two forms have been fully treated of under their respective articles, and will not be further referred to here. *See* Coronary Arteries, Diseases of; and Heart, Aneurism of.

A. **Aneurism of the Intra-Thoracic Aorta.** This may be most conveniently discussed in its clinical aspects under two heads, namely, (1) *aneurism of the arch*, and (2) *aneurism of the descending thoracic aorta*; whilst the former may be subdivided into aneurism of (*a*) the *ascending*, (*b*) the *transverse*, and (*c*) the *descending* portion.

*Relative frequency.*—Of seventy-six cases analysed by the writer, including fourteen treated by himself, the seat of aneurism, single or multiple, stated in the order of relative frequency, was as follows:—*Single*: ascending portion of arch, thirty; transverse portion, seventeen; descending thoracic aorta, ten; ascending and transverse portions of arch, nine; transverse and descending portions, two; entire arch, two; descending portion, one; thoracico-abdominal aorta, one. *Multiple:* ascending portion of arch and descending thoracic aorta, two; ascending portion of arch and abdominal aorta, two.

(1) **Aneurism of the Arch.**—The different parts of the arch of the aorta must be considered separately.

(*a*) *Ascending portion.*—Aneurisms arising from one of the sinuses of Valsalva, within the range of the valves, rarely attain a size larger than that of a billiard-ball. They are saccular and not unfrequently pedunculated, communicating with the aorta by a small orifice. They further exhibit a remarkable tendency to *descend* in the progress of growth, involving in their course the heart or the root of the pulmonary artery. By their position they are sheltered from direct influx from the ventricle, whilst they are exposed to the maximum force of reflux from the aorta. When, however, the orifice is partially or entirely above the level of the valves, the main pressure sustained by the sac is that of efflux from the ventricle; hence the direction of growth is upwards. Aneurism of the portion of the vessel immediately above the level of the valves is especially prone to advance towards the right side, forming a tumour visibly projecting, or detectable by palpation and percussion, in the vicinity of the right nipple. It may be fusiform or saccular, true or false; it usually attains a large size; and, when fusiform, not unfrequently extends over a great portion, or even the whole of the arch. The direction of growth may, however, be backwards or to either side; the aneurism in its progress implicating the œsophagus, the pulmonary artery or one of its branches, the superior vena cava, or either auricle; it is in such cases usually saccular, and of comparatively small size. Aneurisms of the extra-pericardial portion of the ascending aorta usually tend forwards and upwards in the line of main blood-pressure, projecting at the right margin of the sternum above the fourth costal cartilage, and occasionally likewise into the root of the neck, involving the arteria innominata. They may, however, grow backwards and to the right, implicating the right bronchus or lung, or the superior cava; directly backwards, pressing upon the œsophagus or the bifurcation of the trachea; or, projecting mainly towards the left side, they may involve the left branch of the pulmonary artery, and the left bronchus or lung.

Symptoms and Signs.—Aneurism of the sinuses is rarely attended with very definite symptoms; indeed only when it presents at the anterior wall of the chest.

Owing to its position within the pericardium, and its close proximity to the heart, the symptoms produced by aneurism in this situation may be readily confounded with structural or valvular disease of the heart itself. The acoustic signs are, for the purposes of diagnosis, no less indefinite;

because, from the position of the aneurism close to the orifice of the aorta, a murmur produced by it, whether of influx or of efflux, may be easily mistaken for one of the same rhythm caused by obstruction or inadequacy of the valves. The difficulty of diagnosis is further increased by the usual co-existence of atheroma with dilatation of the first portion of the aorta, relative incompetency of the valves, and dilated hypertrophy of the left ventricle. The ordinary symptoms are those of palpitation and derangement of the rhythm of the heart, from affection of the cardiac plexus. But the diseases just mentioned may, in the absence of aneurism, give rise to similar phenomena. The existence of venous stasis and congestion of the upper half of the body, viewed in conjunction with tumultuous and irregular action of the heart, and in the absence of discoverable cause of venous obstruction at a higher point in the chest, would, however, warrant the *presumptive* diagnosis of aneurism at the root of the aorta, implicating the right auricle or the termination of the superior cava; and if with these symptoms were associated systolic murmur at the base, not transmitted in the course of the aorta, or a double murmur, a positive diagnosis to the above effect might be made. Were the diastolic murmur preceded by a distinct second sound, valvular inadequacy from dilatation of the aorta, without valvular disease, would be thereby indicated, and the diagnosis of aneurism *pro tanto* sustained. Symptoms of obstruction of both cavæ, namely, general venous congestion, and engorgement of the liver, would in the foregoing connection justify the special diagnosis of pressure upon the sinus of the right auricle. The symptoms of pressure upon the other chambers of the heart are those only of deranged rhythm and circulation, such as may be due to various causes inherent in the heart. Systolic murmur in the pulmonary artery may result from the pressure of an aneurism on the root of that vessel. Communication of an aneurism with one of the chambers of the heart is usually effected by an aperture not more than two to three lines in diameter. It is the result of progressive absorption, and the symptoms are scarcely to be distinguished from those of antecedent pressure. The physical signs are more characteristic; they consist in a loud murmur, systolic or diastolic, of a 'booming' or 'splashing' character, accompanied by thrill, traceable from the root of the aorta in the direction of abnormal influx, and not transmitted in any of the ordinary lines of valvular murmur. If two murmurs exist, they are fused or converted into a continuous rumble. Sudden transfer of the seat of greatest intensity of such a murmur, from the aortic area to some other point of the precordia, would be conclusive, not only as to the irruption of an aneurism into one of the chambers of the heart, but likewise as to the date of its occurrence.

Aneurism of the ascending aorta, external to the pericardium, is occasionally latent, but ordinarily it is characterised by very definite symptoms and signs. A large fusiform aneurism of this portion of the vessel, or engaging the entire arch, equally expanded, not in contact with the anterior thoracic wall or pressing inconveniently upon any of the adjacent organs, may be virtually latent; exhibiting no symptom of aneurism except vague neuralgic pains darting over the chest, shoulders, arms, and back, and no sign but exaggerated double sound. Pointing externally, or in persistent contact with the chest-wall, an aneurism may be readily identified by the circumstance that it presents a second centre of pulsation and sound. The ordinary pulsation is systolic, expansile, and diffused (though not always equally) over the entire surface; but a second and minor impulse of diastolic rhythm may likewise exist. The former is in many cases accompanied by tactile thrill. The acoustic signs consist either in two sharp accentuated sounds, nearly alike in character, and corresponding in rhythm to those of the heart; or in a single or double murmur of blowing or 'booming' quality. There is likewise absolute dulness, with suppression of respiratory sounds and of vocal fremitus, to the extent of the tumour.

Pressure upon the superior cava is characterised by venous congestion, limited to the upper half of the body: whilst actual communication with that vessel is evinced by cyanosis to the same extent; extreme engorgement with pulsation of the jugular veins; a buzzing systolic murmur, with intense thrill, at the seat of communication and transmitted into the veins of the neck. According to Dr. Mahomed, in cases of arterio-venous aneurism *inspiration* alters the markings of the sphygmograph, by diminishing the volume of blood in the artery. Pressure upon the main bronchus is indicated by diminished or suppressed respiration, with normal percussion-sound, in the corresponding lung; and occasionally by 'whiffing' or 'jerking' inspiratory sound. Diminished respiration throughout either lung, with inequality as between its upper and lower portions, would indicate pressure, but unequal in degree, upon the primary bronchus and its superior secondary branch; whilst partial or complete suppression confined to the upper lobe would show that the superior lobular branch was alone implicated. Passive pneumonia, from occlusion of the pulmonary vessels, is a frequent result of the pressure of an aneurism upon the bronchi. It is worthy of notice that consolidation of lung-substance so produced is especially characterised by the *absence* of vocal fremitus. Bronchitis may likewise arise from mechanical irritation; and where present may, in greater or less degree, mask the physical signs of aneurism. The sudden irruption of an aneurism into one of the bronchi is indicated by copious discharge of florid blood from the mouth and nostrils, and is instantly fatal by syncope or asphyxia. An opening established into the pulmonary substance is followed by 'leakage' of blood, or repeated but limited hæmoptysis. Pressure upon the pulmonary artery is necessarily attended with engorgement of the right chambers of the heart, and general venous congestion; and the establishment of an opening into that vessel, with sudden and urgent dyspnœa without spasm or stridor, extreme congestion of the lung, and hæmoptysis. Death is rapid in such cases; but should an opportunity for physical exploration be afforded, a 'buzzing' systolic hum might be detected in the second and third left intercostal spaces, close to the sternum.

Pressure upon the œsophagus is indicated by dysphagia, referred by the patient to a corresponding point of the chest. Dysphagia due to the pressure of an aneurism is remittent, and varies in some degree with posture—traits by which it is distinguished from that produced by cancer. Dysphagia from volvulus of the œsophagus may, however, exhibit similar variations.

(*b*) *Transverse portion.*—Aneurisms of this portion of the aorta are usually fusiform: they involve mainly its anterior and superior wall, pushing forward the upper end of the sternum, projecting into the neck, compressing the left innominate vein, and modifying, in many cases, the circulation in the primary arteries and their branches. They likewise frequently press backwards upon the œsophagus and trachea, the pneumogastric or sympathetic of either side, or the left recurrent nerve. Owing to the backward course of the left extremity of the arch, aneurisms arising from this portion of the vessel rarely appear in front. They project above the left clavicle, involving the innominate vein, the pneumogastric, sympathetic, or recurrent nerve of the left side, and occasionally all three; or posteriorly in the left scapular region.

Symptoms and Signs.—Pressure upon the left innominate vein is accompanied by visible engorgement of the thyroid, left jugular, subclavian, brachial, and superficial thoracic veins and their tributaries, with œdema of the left arm. The circulation in the carotid or subclavian artery of one side is often diminished or suppressed by the lateral pressure of an aneurism, or by clot-formation in the sac. Pressure upon the trachea is indicated by clanging or metallic cough, and stridor 'from below,' that is, loudest at the upper part of the sternum, and distinctly audible over the lower cervical and upper dorsal vertebræ. The symptoms of aneurismal pressure upon the sympathetic, pneumogastric, and recurrent nerves are most frequently exhibited on the left side only. Those due to implication of the sympathetic or its cilio-motor roots are manifested in the pupil on the affected side. They consist in dilatation or contraction of the pupil according to the degree of pressure; the former from irritation, and the latter, which is the more usual phenomenon, from paresis of the nerve. Laryngeal stridor, huskiness or loss of voice, and harsh metallic cough, in the absence of local disease of the larynx, are eminently diagnostic of pressure upon either recurrent nerve. By means of the laryngoscope the vocal cord on the side of disease, and in rare cases the cords on both sides, are seen to be fixed during breathing and vocalisation, from unilateral or bilateral paralysis of the abductor muscles of the larynx. Dr. George Johnson holds that unilateral paralysis is distinguished by slight huskiness of voice, with stridor on full inspiration; and bilateral paralysis, by permanent dyspnœa and stridor. Paroxysmal dyspnœa or fatal asphyxia may result from collapse of the arytænoid cartilages in such cases. Pressure upon either pneumogastric is especially characterised by paroxysms of remittent spasm of the glottis, which may be suddenly fatal; but, where the recurrent nerve is not likewise implicated, persistent stridulous breathing, aphonia, and metallic cough are not exhibited. The writer has occasionally witnessed urgent laryngeal and bronchial spasm from the pressure of an aneurism, engaging the root of the lung, upon the pulmonic plexus exclusively.

The physical signs are identical with those already described in connection with aneurism of the ascending portion of the vessel.

(*c*) *Descending portion.*—Aneurism of the left curvature and descending portion of the arch involves the left recurrent nerve in nearly every instance. In the progress of growth it passes into the root of the neck; backwards towards the left scapula; or backwards and outwards into the substance of the lung.

Symptoms and Signs.—These include symptoms of pressure upon the recurrent or pneumogastric nerve, as well as the subclavian or internal jugular vein; a pulsating tumour in the left interscapular space, which may attain very large proportions; and signs of congestion and consolidation of the upper and back part of the left lung. In the last case the aneurism, being involved in the pulmonary structure, may afford no specific evidence of its existence.

The physical signs differ in no respect from those which characterise aneurism of the other portions of the arch.

(2) **Descending Aorta.**—Aneurisms of the upper portion of this division of the vessel rarely attain a large size. They may pass upwards and to the right side, implicating the trachea and œsophagus; or directly to the right, stretching the œsophagus or thoracic duct, and ultimately opening into one of them, or into the right pleura. In a case which came under the writer's notice, the trachea and the œsophagus were simultaneously perforated, and death occurred by hæmorrhage into both. The aneurism may advance to the left, and ultimately prove fatal by rupture into the left pleural cavity; it may erode the vertebræ and ribs, and point in the left infrascapular region; or it may advance towards the anterior wall of the chest, displacing the heart, and involving itself in the substance of the left lung. Aneurism of the lower part of the vessel usually extends into the abdomen, constituting the thoracico-abdominal form of the disease. It may displace the heart forwards, and the liver downwards; it may likewise extend backwards, eroding the vertebræ, and pointing in the lower dorsal or the lumbar region on the left side. Finally, an aneurism in this situation may prove fatal by simultaneous hæmorrhage into the left pleural cavity and left retro-peritoneal space, or into the vertebral canal.

Symptoms and Signs.—To what has been already stated on this subject it is only necessary to add, that progressive absorption of the vertebræ is indicated by fixed and boring pain referred to a particular point of the vertebral column, which is tender to pressure, and whence not unfrequently radiating or 'nipping' pains extend round the chest. Forward displacement of the heart by an aneurism would be characterized by violent impulse, simulating that of cardiac hypertrophy (the distinction would rest upon the presence of the special symptoms and signs of aneurism); a remarkable derangement of cardiac impulse, constituting the 'double jog' of Hope; with absence of the positive signs of

hypertrophy. Pressure upon the thoracic duct is very rare; it would be indicated by the symptoms of mal-assimilation, wasting, and inanition, —symptoms which are foreign to aneurism under its ordinary forms.

The physical signs of aneurism of the descending thoracic aorta are ordinarily limited to a sharp sound, single or double, audible over the dorsal vertebræ and somewhat to the left; and, more rarely, perceptible impulse. The existence of murmur is exceptional; when present, murmur is all but invariably single and post-systolic, and is inaudible in the erect posture.

Duration and Terminations.—The duration of aneurism of the intra-thoracic aorta may vary from a few days to several years. Death is most frequently caused by rupture of the sac into various parts; or by gradual exhaustion from insomnia and inanition. Of seventy-one cases of aneurism in this situation tabulated by the writer, including twelve observed by himself, twenty-six were fatal by rupture of the sac; namely, into the pericardium ten—all being aneurisms of the ascending aorta; into the left lung or pleura five—four being of the transverse, and one of the descending thoracic aorta; into the trachea four—three of the transverse, and one of the ascending aorta; into the right lung or pleura three—two of the ascending, and one of the descending thoracic aorta; into the left bronchus or œsophagus three—two of the descending thoracic, and one of the transverse aorta (in one of these an opening existed both into the left bronchus and the œsophagus); externally one—the aneurism having arisen from the transverse aorta. Death may also result from asphyxia, intercurrent inflammation of the lungs or pleura, or from coma.

**B. Aneurism of the Arteria Innominata.** Aneurism involving the innominate artery may be mistaken for aneurism of the aorta, at or near the first curve of the arch.

Symptoms and Signs.—Those which are most distinctive of innominate aneurism are the early appearance of pulsating tumour above the right clavicle, accompanied by arterial obstruction on the right side; displacement of the trachea and larynx to the left; and pulsation with sound, localized at the right sternoclavicular joint and immediately above. Diminished circulation in the right carotid and subclavian arteries at an early period of the disease, and the reduction or arrest of pulsation in the sac by digital pressure upon these vessels, afford the most constant and least equivocal evidence of innominate aneurism. The early occurrence of neuralgic pains in the right side of the neck, the right shoulder and ear, followed by œdema and partial paralysis of the right arm, are likewise suggestive of innominate, as distinguished from aortic aneurism. The symptoms of nerve-pressure on the right side, as exhibited in the larnyx and pupil, are usually well-pronounced in this disease. The physical signs are in no respect different from those of aneurism of the arch. Concurrent implication of the aorta is ordinarily determined with the greatest difficulty, and occasionally a positive diagnosis in this respect cannot be made. If pulsation and sound of maximum intensity exist at the level of the second costal cartilage, or an inch and a-half below the sternal end of the clavicle, whilst the pulse-tracing of the right radial artery exhibits imperfect aneurismal characters, the aorta may be considered as involved in the disease.

**C. Aneurism of the Pulmonary Artery.** Aneurism of the main trunk or primary branches of the pulmonary artery is unknown; but aneurism and ectasia of the secondary and subsequent branches have been repeatedly found in connection with cavities in the lungs, and are recognised as the ordinary source of fatal hæmoptysis in the third stage of phthisis. Cavities confined to one lung with walls condensed by fibroid growth, and either stationary or in process of secondary ulceration, are those which are most favourable to the formation of pulmonary aneurism or ectasia. In the walls or trabeculæ of such cavities the branches of the pulmonary artery remain pervious; their coats, already thickened by chronic inflammation, and weakened by degenerative changes, expand under vascular pressure, where least supported, and form an aneurism, globular, fusiform, or semi-fusiform, according to the extent and degree of their structural change and denudation, or a simple ectasia. These ultimately give way by rupture or erosion, and severe hæmorrhage into the cavity and connected bronchia is the immediate result. Active ulceration of an existing cavity is usually attended with partial thrombosis of adjacent vessels. Hence, in such cases hæmoptysis is seldom copious, and death results from exhaustion produced by repeated small hæmorrhages. In the process of primary and active excavation of lung-tissue the vessels are completely blocked, and hæmoptysis, even to a small amount, is exceptional. *See* Hæmoptysis.

Symptoms and Signs.—Of a special kind there are absolutely none. Copious hæmoptysis in connection with cavity would be eminently suggestive of pulmonary aneurism. Of twelve cases of fatal hæmoptysis in the third stage of phthisis, tabulated by Dr. Douglas Powell, a ruptured aneurism or ectasia of a pulmonary branch was found to be the source of hæmorrhage in eleven instances.

Treatment.—The treatment of aneurism will be found described in the articles Abdominal Aneurism; and Aorta, Diseases of. The *curative* treatment of aortic or innominate aneurism should be directed to the single object of effecting consolidation of the contents of the sac. With this object in view three methods have been pursued, either separately or conjointly, namely, the *postural* and *dietetic*; the *medicinal*; and the *surgical*. As complemental of the first plan of treatment of thoracic aneurism, an occasional blood-letting by venesection, to the amount of eight to ten ounces, for the purpose of reducing arterial tension or venous engorgement, may be demanded. With a view to causing or promoting deposition of fibrin in the sac several agents have been used, namely, acetate of lead, in doses of four to eight grains; iodide of potassium, ten to thirty grains; and aconite, five minims of the tincture thrice daily. Ergotin has been used hypodermically by Langenbeck. Each of these agents has been credited with success in the treatment of aneurism. But, as spontaneous

cure has been occasionally witnessed under favourable circumstances as to diet and rest, where no medicine had been given, a more than promotive influence, by retarding the circulation and reducing vascular pressure, can scarcely be assigned to the medicine used, where rest and restricted diet have been observed. Galvano-puncture of the sac has been practised with success. Deligation of the common carotid artery, or of that vessel and the subclavian, may be followed by the most favourable result, in cases where pressure upon these vessels has been found to control pulsation in the sac. For details of the surgical treatment see ANEURISM.

The *palliative* treatment of thoracic aneurism is discussed in the article AORTA, Diseases of. A few leeches applied from time to time in the vicinity of the sac, or a hypodermic injection of morphia, will relieve the pain and repress the inflammation caused by excentric pressure.

THOMAS HAYDEN.

**THORACIC DUCT, Diseases of.**—SYNON. Fr. *Maladies du Canal thoracique*; Ger. *Krankheiten des Ductus thoracicus.*—The thoracic duct is the main trunk belonging to the absorbent system, by means of which the chyle from the lacteals, and the lymph from the lymphatics (except that from the right side of the chest, neck, and head, and the right arm), are conveyed into the circulatory system, so that these fluids may be mixed with the blood. It starts from the receptaculum chyli, deep in the upper part of the abdominal cavity; passes through the aortic opening of the diaphragm, on the right of the aorta; accompanies this vessel along the thoracic cavity; passes beneath its arch and the left subclavian artery; then along the left side of the œsophagus; and, finally, comes forward in the neck from behind the left carotid artery, arching over the subclavian artery, and crossing the phrenic nerve and anterior scalenus muscle, to open usually into the left subclavian vein, near its junction with the internal jugular. It is requisite to remember these facts respecting the course and anatomical relations of the thoracic duct, in order to understand how its chief morbid conditions are produced.

The diseases of the thoracic duct resemble those of the absorbent vessels generally (*see* LYMPHATIC SYSTEM, Diseases of); and it will suffice to indicate here the following practical points:—1. The passage of fluid along the duct, and its escape into the subclavian vein may be impeded by any condition which interferes seriously with the venous circulation, and distends the veins considerably, such as certain cardiac diseases. 2. Local obstruction of the thoracic duct may arise at any point, from direct pressure upon it, especially by an aortic aneurism, and it may become thus permanently occluded; or from intrinsic tubercular disease, which is of special importance (*see* memoir by Stilling, Virchow's *Archiv*, and *Lancet*, vol. i., 1882). 3. As a result of obstruction, dilatation of the portion of the tube behind this point will probably supervene in various degrees, and it may become considerably enlarged and thickened. The other portion tends to become contracted and atrophied. 4. Perforation of the thoracic duct occurs in exceptional instances, owing to the destructive effect of an aneurism or other morbid condition, or as the result of injury.

It is, as a rule, quite impossible to determine during life that the thoracic duct is diseased. This might be suspected if, along with some known cause which might lead to obstruction of the tube, the patient became extremely emaciated, anæmic, and weak, without other obvious reason to account for these symptoms. No treatment directed immediately to the thoracic duct can be practicable under any circumstances.

FREDERICK T. ROBERTS.

**THORACIC TUMOUR.**—A tumour within the chest. *See* BRONCHIAL GLANDS, Diseases of; LUNGS, Malignant Disease of; MEDIASTINUM, Diseases of; and THORACIC ANEURISM.

**THORAX, Diseases of.** *See* CHEST, Diseases of; CHEST WALLS, Diseases of; and DEFORMITIES OF CHEST.

**THORAX, Examination of.** *See* PHYSICAL EXAMINATION.

**THREAD-WORM.**—SYNON.: *Oxyuris*; Fr. *Oxyure*; Ger. *Spitzschwanzwurm; Fadenwurm.*

As stated under the article OXYURIS, thread-worms represent a genus of nematoid worms. They are commonly spoken of as *Ascarides*, but this is a misnomer. The oxyurides, or thread-worms, are also sometimes termed *seat-worms.* By whatever name called, they have acquired much clinical importance, since they prove injurious not only to young persons, but also to people advanced in life. It may be said, indeed, that they are more annoying to adults than to children; the prognosis in cases of the former being more unfavourable than in the latter. It is usually stated in manuals that these parasites reside in the rectum of the human bearer; but this is an error, since their presence in the lower bowel is rather an accident than otherwise. No doubt they are frequently present, both in the rectum and sigmoid flexure of the colon, but their true habitat is higher up, namely, in the cæcum. Probably the tendency to migrate is the chief cause of their frequent presence in the lower bowel; at all events, their passage by the anus at night-time is a constant source of distress to young persons. Their wanderings thence into the vagina, and about the neighbouring parts, proves an additional source of serious irritation and discomfort, often leading to the involuntary practice of objectionable habits. It is of the utmost importance to get rid of them, especially at the age of puberty. Before we speak, however, of the symptoms and treatment, it may be as well to say a few words respecting their modes of introduction into the human body. Until lately nothing had been done to clear up the mystery of their origin. It was generally supposed—and this view is still held by some unscientific persons—that these entozoa were generated only in individuals affected by a peculiar cachexia. The enfeebled condition produced by their presence was pronounced to be the cause instead of the effect. Many practitioners cannot shake off their old notion, and some few are impatient of correction in this respect. A healthy person is just as

liable to be attacked by nematoid worms as a diseased one. The real question is, How do the germs gain access to the human body? Various experiments, in which the writer has himself taken part, have been conducted with the view of determining this important point.

Everyone is familiar with the size and appearance of the common thread-worm (*Oxyuris vermicularis*), at least of the females, which are more numerous than the males. If one of the former, measuring nearly half an inch in length, be submitted to a magnifying power of twenty diameters, the uterine ducts will be seen to contain a multitude of eggs. Those ova whose contents are in the most advanced stage of development already show a more or less perfectly formed and tadpole-shaped embryo. These embryos, after extrusion of the eggs from the maternal body, soon acquire the ordinary vermiform character. As Vix and Leuckart have shown, 'one needs only to expose the eggs to the action of the sun's rays in a moistened paper envelope, when, at the expiration of some five or six hours, the tadpole-shaped embryos will have already become slender elongated worms. At this stage they are not altogether unlike the sexually mature oxyurides in shape, exhibiting rather lively movements under the application of warmth' (*Die Mensch. Par.*, Bd. II. s. 130). Professor Heller has remarked to the writer, that for the artificial rearing of the vermiform embryos no plan is better than that of simply placing the eggs in a glass tube filled with saliva. This tube may be conveniently carried in the arm-pit, when in a very short space of time the embryonal transformations may be followed. In this connection it is a matter of practical importance to know whether or not these and all other embryonal changes which are necessary to the sexual maturity of the parasite, can be accomplished within the human bowel. On this point Leuckart affirms (*loc. cit.* s. 329) that 'elongated embryos are to be found not only in the fæces but also in the mucus of the rectum above and around the anus.' And it appears that Vix, who was the first to discover the filiform stage, has detected vermiform embryos, along with eggs of oxyurides, in the large intestine. These statements, taken by themselves, would seem to show that, notwithstanding all that has been said to the contrary, the old view as to the propagation of thread-worms in the human bearer is correct. All the more recent evidence, however, leads to a contrary conclusion. Thus Leuckart distinctly states that *ordinarily* the escape of the embryos 'takes place under the action of the gastric juice, and *primarily* also under that condition when by some means or other they have gained access to a new bearer' (*loc. cit.* s. 329). Speaking also of the subsequent development of oxyuris-embryos, he says: 'The development of these embryos continues not merely in the free state (when the favourable conditions are thus afforded) but also—at least in the human species—in the intestine of the bearer, presupposing of course that the eggs remain there the necessary time.' What Leuckart conjectured to occur really does take place. According to Heller, who has made experimental observations on this subject, the embryos, after being liberated in the human stomach, escape into the duodenum and upper bowel. In this situation the vermiform embryos undergo a series of moultings, accompanied by organic changes, and growing with great rapidity, soon reach the cæcum, where they finally arrive at sexual maturity. As the question at present stands, therefore, we conclude that our patients ordinarily contract thread-worms by swallowing the eggs of oxyurides. This they may do by ingesting them with uncleaned fruit, and other kinds of food, to which the eggs have become adherent; but, undoubtedly, the most common way in which the disease is prolonged, if not at first contracted, is by swallowing fresh germs conveyed directly to the mouth by the hands of the patient. The writer has had a gentleman under his occasional care, who confessed that, in his rage with these disgusting parasites, he had taken them alive between his teeth and bitten them. In this exceptional way he must, of course, have liberated thousands of ova at a time, a fact which accounts for the myriads of adult oxyurides by which he is infested. Patients frequently handle these parasites, and still more frequently carry the ova under the nails. Children and also grown persons become infected by biting their nails after scratching the anus. The writer lately met with an instance where, from only the vestige of a nail left upon a boy's thumb, he obtained some ova of oxyurides. Thus, it is obvious that without great cleanliness, persons already harbouring thread-worms are liable to increase the number of their parasitic guests.

FIG. 95. *Oxyuris vermicularis*, female. Highly magnified. After Leuckart.

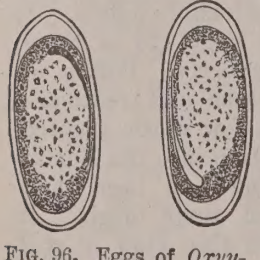

FIG. 96. Eggs of *Oxyuris vermicularis*, inclosing tadpole-shaped embryos; × 450 diam. (original).

Personal cleanliness is thus essential, but it is, we think, going too far to say, with Dr. Ransom, that 'probably any infected person who adopted the requisite precautions against reinfection from himself or others would get well in a few weeks without treatment by drugs.'

SYMPTOMS.—The symptoms produced by thread-worms are very variable. Unpleasant sensations show themselves generally in the evening and at night, consisting ordinarily of heat and irritation around the anus. These phenomena often become excessively distressing, especially when they are accompanied by itching within and about the genito-urinary passages. By the wandering of the worms local inflammatory action is set up. Presently, various sympathetic phenomena are superinduced, such as simple restlessness, general nervousness and irritability, itchings at the

nose, involuntary spasms, chorea, convulsions, and epileptiform seizures. At early puberty the local irritation sometimes induces the sufferer to seek relief by practices which show a perverted condition of the sexual functions, and in young females these phenomena are occasionally accompanied by leucorrheal discharges, with more or less hysteria. Cases exhibiting varied and anomalous symptoms in connexion with the presence of these and other worms are recorded by different writers, but not many presenting the severer phenomena from thread-worms have appeared in our English journals. In one case, where multitudes of oxyurides were present, a patient of the writer's suffered from anæmia, deafness, and extreme prostration, the feebleness being so marked that the young lady could not even bear the exhibition of ordinary vermifuges (*Worms*, 1872, case liii. p. 94).

Prognosis.—Speaking generally, the prognosis in cases of thread-worm is favourable or otherwise, according to the age of the sufferer.

Treatment.—In young persons small doses of steel, followed by brisk saline purgatives, sometimes suffice to expel most, if not all, of the parasites. If the worms return, a repetition of the remedies may be advised, increasing the doses. As a rule, the threadworms will return, and if very numerous they are apt to prove obstinate. In adults the results of treatment are far less satisfactory. The worms are expelled with more difficulty by cathartics, and even copious enemata fail to reach those worms that are lodged high up in the colon and cæcum. Many patients object to injections altogether; but if, containing turpentine, they can be employed two or three times weekly, whilst active salines are given by the mouth, there is probably no better mode of obtaining good results. A great variety of drugs have been recommended, such as calomel, scammony, jalap, salt, santonin, iron, aloes, and assafœtida; one or other of these being administered separately or together, followed by medicated enemata containing either lime, tincture of steel, sulphuric ether, tansy, or quassia. It may be said that all of these remedies prove more or less useful, but the writer has of late years relied more upon moderate doses of aloes and assafœtida, followed by copious draughts of active mineral waters, such as those of Friedrichshall, Pullna, and Hunyadi-Jànos. Many persons who object to drastic cathartics as ordinarily prescribed will not refuse to take the Friedrichshall waters by themselves, or the Hungarian waters in combination with steel or other tonics, to any reasonable amount. In the writer's experience these waters are of great value in the treatment of certain forms of entozoal disease, especially of threadworms. Whatever drugs are given, it is especially necessary that attention be paid both to diet and regimen. All green vegetables should be avoided, whether cooked or uncooked. The utmost cleanliness must be enjoined. Daily local washings are, above all things, to be insisted on, especially after the act of defæcation, or nightly at bed-time, whether or not enemata be employed. Simple cold water or olive oil injections are almost as beneficial as those that are medicated. The nails must be kept short and clean, and the practice of biting them should be denounced. Under any circumstances, and in view of a permanent cure, not only is great perseverance in the employment of the remedies necessary, but also in the matter of general cleanliness. *See* Ascarides; Oxyurides; and Seat-worms.

T. S. Cobbold.

**THROAT, Diseases of.**—Synon.: Fr. *Maladies de la Gorge*; Ger. *Rachenkrankheiten.*

The throat is a comprehensive term, its diseases including those of the pharynx, tonsils, palate, and uvula, and in popular language even those of the larynx and trachea. The principal affections of these different structures, with the exception of the palate, are described in their appropriate articles, to which the reader is referred, and here it will only be necessary to offer a few general remarks on throat-diseases, and to refer briefly to the affections of the palate. In many instances all the parts are more or less involved in the morbid conditions present, but in other cases one structure is mainly or exclusively involved. Moreover, the throat may be interfered with by neighbouring diseases, such as retro-pharyngeal abscess, and some affections of the neck.

Summary of Diseases.—The affections of the throat may be thus grouped in a general way:—1. There may be no actual disease, but the patient merely complains of various sensations referred to the throat, these being of a nervous character. 2. The throat is liable to injury by substances swallowed. 3. This part is obviously affected in certain general diseases, especially some of the acute specifics. Thus it is particularly involved in scarlatina and diphtheria, and to a less degree in measles, rötheln, influenza, and general catarrh. Syphilis also implicates the throat in its various stages. This region is sometimes attacked by erysipelas, small-pox, herpes, or thrush. 4. Acute congestion, and various forms of acute inflammation, affecting different structures of the throat, are of common occurrence, resulting from causes acting either locally or generally. The cases present much diversity in their severity, depending upon the extent, seat, and terminations of the inflammation. 5. Chronic congestion and inflammation are also not uncommon, of various degrees, and producing different effects in different cases. 6. Ulcerations of the throat are of frequent occurrence, being usually dependent on some general condition, such as syphilitic, scarlatinal, or diphtheritic ulcers, but sometimes local in their origin. They may become sloughing and gangrenous, causing much destruction of the tissues, or even opening up vessels, and thus proving fatal by hæmorrhage. The after-effects of ulceration may be evident in the way of cicatrices, contraction, adhesions, and permanent loss of parts. 7. Certain structures in the throat are very liable to become relaxed, and thus to produce symptoms, especially the uvula. 8. The throat may be occupied by some enlargement or morbid growth. Here may be mentioned chronic enlargement or so-called hypertrophy of the tonsils, which, however, is usually the result of chronic inflammation, congestion, or albuminoid disease. Cancer and polypi are the forms of

morbid growth usually met with, and cancer may proceed to ulceration. 9. Malformations are not uncommonly of importance in connection with the throat. The size of the pharyngeal cavity varies much in different persons, but its unusual smallness may be of more or less consequence. Deformities of the palate are of much importance, being either congenital or the result of disease. 10. Sensory or motor paralysis involving the throat is sometimes a serious affection. The condition is especially met with after diphtheria, or in cases of labio-glosso-laryngeal paralysis.

Clinical Signs.—The symptoms in throat-affections are very variable, as regards their severity, exact nature, and combinations, but they are more or less of the following nature:—1. Painful or other abnormal sensations are usually complained of. Pain may range from mere 'sore-throat' to marked suffering, and in some instances it is attended with throbbing, or shoots towards the ear. Tenderness is also very common, when anything passes over the surface, or even when the parts are moved in the act of swallowing, and the painful feeling may be only experienced at this time. Talking or coughing is sometimes painful. Tenderness may also be felt when pressure is made over the tonsils from without. Amongst other sensations often complained of are a sense of dryness, irritation, fulness or tightness, heat or burning, and obstruction. 2. Not only may the act of deglutition be painful, but in throat-disease it is often attended with difficulty in various ways, and may be quite impracticable (*see* Deglutition, Disorders of). 3. Articulation is affected in certain conditions, the voice being characteristically altered, and becoming of a thick, guttural, or nasal quality. In other cases it is slightly rough or husky, and, of course, is particularly liable to be affected if the larynx is involved in any way. 4. In some forms of throat-disease the breathing is obstructed, owing to structures filling up more or less the passage of the pharynx. This is especially felt in the recumbent posture; and patients suffering in this way often breathe with the mouth wide open, and snore loudly. The breath may have an unpleasant or even fœtid smell, as the result of morbid states of the throat. 5. Throat-affections frequently excite the acts of hawking or coughing, and various materials are thus expelled in many cases. It may also be mentioned here that some irritation in the pharynx not uncommonly causes reflex vomiting. 6. Morbid conditions in this part may give rise to hæmorrhage, and this occasionally proves of a serious or even fatal character, as the result of certain destructive lesions. 7. Physical examination of the throat is of essential importance in revealing its morbid conditions. Inspection is usually sufficient, with the aid of a good light, and it is in most cases necessary to depress the tongue by means of the finger, the handle of a spoon, or a tongue-depressor. In some instances it is requisite to feel the parts in the throat with the finger. External examination should also be made beneath the angles of the lower jaw. The objective conditions determined by physical examination will depend on the nature of the disease.

**Palate, Diseases of.**—The palate consists of two parts—namely, the hard, and the soft palate with its arches. This structure takes an important share in the performance of deglutition, as well as in articulation. It is liable to be affected by any of the morbid conditions which are met with in the throat, and assists in the production of the symptoms resulting therefrom. When the palate is inflamed or ulcerated, marked soreness or pain is likely to be felt when anything passes over its surface in the act of swallowing. As a rule it can be very readily inspected. The points that demand special notice with reference to the palate are, that it is not uncommonly the seat of more or less extensive congenital deficiencies, as in the different forms of cleft palate; and that it may be destroyed in various degrees during the progress of ulceration, in some instances a perforation remaining, in others the whole soft palate being removed, or even the hard palate involved. Consequently the two functions above referred to are often seriously impaired. During the act of deglutition, substances tend to pass back into the nasal cavities through the posterior nares, especially liquids; while speech is nasal or guttural and indistinct, or in some cases almost unintelligible, it being impossible for the patient to articulate the words properly. During the act in some cases the features are more or less distorted.

Treatment.—For the treatment of the different throat-affections the reader must refer to the articles in which they are respectively discussed. The writer only mentions the subject in order to draw attention to two points, namely: first, the great importance of *general* treatment in a large proportion of cases of affections of the throat; secondly, the necessity of using *local* measures *efficiently*, when these are required; while at the same time it is often most desirable that the parts affected should be kept as much at rest as possible. Should the palate be congenitally deficient, or destroyed by disease, surgical operations are often of the greatest service; or plates of different kinds may have to be worn.

Frederick T. Roberts.

**THROMBOSIS** (*θρόμβος*, a clot).—Synon.: Fr. *Thrombose*; Ger. *Thrombose*.

Definition.—The coagulation of fibrin in the heart, blood-vessels, or lymphatics during life.

Description.—Thrombosis may take place in the heart, the arteries, the capillaries, the veins, and also in the lymphatics. The coagulum consists of fibrin, entangling in its meshes a larger or smaller number of blood-globules, which, in rapidly formed thrombi, consist of both red and white varieties, and hence the thrombus is at first dark-coloured. In slowly-formed thrombi, and in those due to projections from the coats of the vessels, the red cells may be absent, and the thrombus is colourless or yellowish-white. In most thrombi the white cells are present in a much larger proportion than in normal blood.

When a thrombus occupies the place where coagulation began, it is called a *primitive* thrombus; when it gradually extends from this point along the vessel, an *extension* or *produced* thrombus. This extension usually proceeds along the vessel to its junction with a large

branch, into which the thrombus may often be seen to project with a rounded extremity, and this, by obstructing the blood-current, may again form the starting point for a fresh extension.

Structurally, thrombi may be distinguished as *laminated*, and *non-laminated* or *uniform*. The former result from a process of continuous, the latter from one of intermitting coagulation. In laminated thrombi there is often a layer of white blood-cells between the laminæ, due to the tendency which these bodies have to wander out of the clot.

Thrombi may further be distinguished into *parietal*, or those which adhere to some part of the wall of the vessel; and *obliterating*, or those which completely fill the vessel. Parietal thrombi are generally nearly colourless, and are due to some roughness or other change in the lining membrane. Obliterating thrombi, which are at first coloured, are produced by the sudden coagulation of the blood; the thrombus thus formed shrinks, and leaves a space which again fills with blood; this again coagulates, and so complete obstruction of the vessel is effected. A *post-mortem* coagulum never completely fills the vessel, as after the shrinking process has taken place, there is no further supply of blood to coagulate. Other points of distinction between *post-mortem* coagula and thrombi are these—the former are never laminated; they are looser in texture, and moister; they do not adhere so closely to the wall of the vessel; and though they may be either coloured or colourless, they never present the appearances due to the subsequent changes which take place in thrombi.

Changes in Thrombi.—The first change observed after the thrombus has shrunken and become denser is *decolorisation*. The colouring matter dissolves out of the blood-globules, becomes diffused, and is transformed. The thrombus accordingly changes from dark red to tawny, and finally to a yellowish-white; and at the same time it loses its soft elastic texture, and becomes tougher, denser, or even somewhat friable.

The subsequent changes vary. First, a process of *shrinking* and drying up may occur, by which the thrombus gets converted into a tough leathery substance, which may even become calcified, and in this way are formed the concretions in veins known as *phleboliths*.

Secondly, *softening* may take place; this may either be due to a process of molecular disintegration, or more rarely to suppuration. In the former case the thrombus liquefies into a milky fluid, consisting of an oily and granular detritus, the process beginning in the centre. In the heart this change often occurs in the layers of fibrin entangled among the trabeculæ, or in the globular masses which sometimes project from them into the cavities, thus giving rise to the formation of cysts.

*Suppuration* is occasionally seen in the thrombi of veins surrounded by, or leading from, inflamed parts; a multiplication of leucocytes takes place in the thrombus, either by proliferation or immigration, and the whole softens down into a purulent fluid. In these cases the wall of the vein itself is always inflamed. These softened and broken-down thrombi are a common cause of embolisms.

Lastly, the thrombus may become *organised*. Organisation has been chiefly studied in wounds and ligatures of arteries and veins, and the appearances have been very differently interpreted by different observers. According to one opinion the thrombus itself becomes organised; the white blood-cells contained in it, or immigrant leucocytes from the vasa vasorum, as proved by including a portion of vein between two ligatures and impregnating the blood with vermilion (Bubnoff), become converted into stellate connective-tissue corpuscles, with interlacing processes; new vessels permeate the clot along the line of the stellate processes from the unobstructed portion of the artery or vein, and form anastomoses with offshoots from the vasa vasorum perforating the tunica intima, which disappears; and thus a vascular reticulated connective tissue is formed, in the meshes of which lie the remains of the red blood-globules and fibrin of the clot. The progressive dilatation of the newly formed vessels gradually renders the thrombus cavernous; and finally, by their coalescence, it entirely disappears, and the vessel again becomes pervious. Cornil and Ranvier dispute the correctness of these observations, and assert that the appearances are really due to the outgrowth, from the tunica intima, of vascular granulations penetrating the thrombus, which gradually disappears without taking any part in the formation of the reticulated connective tissue which is found occupying its place.

Pathology.—According to the views of coagulation now entertained, the formation of fibrin is due to the interaction of two substances present in the liquor sanguinis: fibrinogen, and fibrinoplastin or paraglobulin, under the influence of a third substance which acts analogously to a ferment. The fibrinoplastin and the ferment are contained in the white blood-cells, and are, in all probability, derived from these bodies, for in all spontaneously coagulable fluids white blood-cells are present, and where they are absent coagulation does not take place. Even in the blood, when coagulation is retarded, as by keeping horse's blood in a tube formed of the excised jugular vein, it is found that the upper layers, from which the white cells have subsided, coagulate very imperfectly, while a firm clot forms in the lower layers, where the corpuscles are numerous. The white blood-cells also are often seen to form the starting point from which the threads of fibrin form.

The nature of the process of coagulation is still very obscure. It does not appear to resemble a chemical precipitate, and it is very doubtful whether the fibrinoplastin actually enters into the formation of the clot; for in artificial coagulation, effected by adding fibrinoplastin to fibrinogen, the weight of the clot is always less than that of the fibrinoplastin used.

As all the three factors of coagulation, fibrinogen, fibrinoplastin, and the ferment, are present in the liquor sanguinis, it is evident that there must be some restraining influence which prevents coagulation; and the cause of thrombosis must be looked for in the removal or weakening of this influence. According to Brücke, contact with the healthy lining membrane of the vessels prevents the blood from coagulating; consequently

any structural change in this membrane is liable to cause thrombosis. The presence of a foreign body produces the same effect, and a thrombus itself acts as a foreign body. Retardation or arrest of the blood-current is also a common cause of thrombosis. Loss of motion in itself tends to retard coagulation, but free circulation is necessary for the maintenance of the nutrition and integrity both of the vessels and the white blood-cells; hence stagnation tends to cause thrombosis by removing the restraining influence of the healthy vascular wall, and also by setting free fibrinoplastin from the white corpuscles; moreover, the motion of the blood maintains the contact between each particle and the lining membrane of the vessels, and so prevents coagulation.

The principal causes, therefore, of thrombosis are alterations in the lining membrane of the vessels, and retardation or arrest of the circulation; to these may be added the presence of foreign bodies, and probably also the microzymes of septic processes.

Hyperinosis, or increase in the constituents of the fibrin, and diminished fluidity, as in cholera, can only be regarded as predisposing causes requiring retardation of the circulation to take effect.

Retardation of the circulation being one of the most important causes of thrombosis, we find, as might be expected, that its most frequent seat is the veins, where the circulation is naturally feeble.

Varieties.—1. *Venous.*—The principal causes of venous thrombosis are two. The first of these is wounds and injuries of veins, where the formation of thrombi is the natural way of arresting hæmorrhage. The thrombus may extend along the vein from its primitive seat, and thus cause blocking of venous trunks at a distance from the site of the injury. This is often seen after parturition, when thrombosis of the uterine sinuses may extend to the iliac and femoral veins. Secondly, inflammation of the coats of the vein, by altering the condition of the lining membrane, may cause thrombosis; but in many cases of phlebitis the thrombosis is the primary change, and the inflammation of the coats is set up by it. Other causes of venous thrombosis are pressure on the veins, dilatation, and arrest of the circulation in the capillary territory of the vein, as from embolism or inflammatory stasis. Hence we occasionally find the veins leading from inflamed organs thrombosed. Lastly, thrombosis of the veins is not unfrequently due to retardation of the circulation, owing to failure of the propelling power of the heart, in cases of marasmus and exhausting diseases. These thrombi are most frequently met with in the veins of the lower extremities and pelvis, next in the sinuses of the dura mater.

2. *Arterial.*—Apart from wounds and injuries, thrombosis of the arteries is most frequently caused by degeneration of the lining membrane, giving rise to rough surfaces to which the coagula attach themselves, and to aneurisms in which the coagulation is due to stagnation; aneurysmal thrombi are commonly laminated. Arrest of the circulation from any cause, as embolism, will also cause thrombosis.

Thrombosis of the larger arteries, without alteration of the lining membrane, is most probably always the result of embolism, the embolus being usually derived in the systemic arteries from thrombi of the heart, the result of asystole. Of this nature are the cases of thrombosis and gangrene of the extremities which sometimes occur in fevers and wasting diseases. Thrombosis of the pulmonary artery may be produced in a similar manner, or the embolus may be derived from a thrombus in the veins.

3. *Cardiac.*—Thrombosis of the heart may be caused by endocarditis, the thrombi then usually forming caps to the inflammatory outgrowths or vegetations. Large thrombi are most commonly caused by imperfect emptying of the cavities and consequent stagnation, due either to stenosis of the orifices, or to want of tone in the muscular walls. Thrombi may also extend into the right auricle from the venæ cavæ.

4. *Capillary.*—Capillary thrombosis may be due to extension from the veins and arteries, or it may be primary. In the latter case the conditions which cause it are imperfectly known; aggregations of white blood-globules will often block the capillaries and small vessels in the manner of thrombi, but this condition is usually transient, and not attended by true coagulation. The inhibitory influence of the lining membrane of the blood-vessels is so powerful in the capillaries that, as long as their structure remains intact, coagulation rarely takes place. Thus inflammatory stasis, or obstruction of the afferent artery by embolism, may exist for a considerable time without the blood in the capillaries coagulating.

5. *Lymphatic.*—Thrombosis of the lymphatics has been chiefly observed in the puerperal condition, in the lymphatics of the uterus and their continuations to the lumbar glands, and in rare instances in the thoracic duct. It is probably due to alteration in the constitution of the lymph, normal lymph having very slightly coagulable properties.

Symptoms.—The symptoms of thrombosis are those of arrest of the circulation, and they differ according to the vessel affected. In the veins, if a main trunk be obstructed, so that a sufficient collateral circulation cannot be rapidly established, the effects produced are passive hyperæmia, venous dilatation, transudation of serum, and sometimes hæmorrhage in the territory of the blocked vein, with enlargement of the collateral channels. In extreme cases moist gangrene may result. Thus, according to the vein affected, we may have anasarca of an extremity, ascites, or hydrothorax; hæmorrhage from the stomach, intestine, or kidney; œdema and cyanosis of the face and neck; and so on. The symptoms of arterial thrombosis are in the main those which have already been described as occurring when the artery is blocked by embolism (*see* Embolism). Coagulation of blood in the arteries of the heart is described in a separate article. *See* Heart, Thrombosis of.

Treatment.—The treatment of thrombosis varies according to the seat of the process. *See* Aorta, Diseases of; Brain, Vessels of, Diseases of; Heart, Thrombosis of; and Veins, Diseases of.

W. Cayley.

**THRUSH.**—Synon.: Fr. *Aphthe*; Ger. *Mundschwamm.*

Definition.—The popular name given to aphthæ in the mouth, and to morbid states resembling them. It is convenient to confine the term *aphthæ* to cases in which the *oïdium albicans* is present; but the term thrush must be allowed a wider signification, and must be taken to include also many cases of simple stomatitis. *See* Aphthæ; and Stomatitis.

Description.—Thrush is characterised by small white flakes scattered over the tongue and the mucosa of the mouth and lips. Occasionally the disease spreads down the œsophagus. It is frequently met with in infancy, and in adults it occurs in the last stages of wasting complaints. The white flakes are composed chiefly of exudation from a small spot of subjacent mucosa, which is acutely inflamed. Thus it is that they are surrounded by a red areola, and that, if they are picked off, they are speedily reproduced. In the cases which are, strictly speaking, aphthous, the white flakes may readily be transferred from the infant's mouth to the mother's nipple. The minute spots of inflammation have a tendency to occur in clusters, and in successive crops, some fading as others appear. They are attended by local heat and tenderness, so that in a severe case the infant can hardly take the breast; and with this there may be feverishness, drowsiness, and perhaps diarrhœa. The white flakes are sometimes so abundant as to coalesce, and form large patches of fur. When these flakes are shed, or are removed, small ulcers are left behind, which are flat and circular or oval, with inflamed bases, and a thin yellowish or greyish slough. Their margins are well-defined, but without thickening or elevation. They are always attended by increased heat and congestion of the mucosa, together with active gastric or intestinal disturbance; and there is fever of a more or less atonic kind.

Treatment.—Thrush in infancy is usually due either to improper or insufficient food, giving rise to an acid state of the secretions of the mouth; and the attention of the medical man should, therefore, be directed particularly to this subject. If the infant is being nursed by its mother, inquiry should be made as to her health, for the disease may perhaps arise, or be kept up, by a morbid condition of the milk. If there be no reason to suspect this, the child should be confined entirely to the breast, and this should be given only at stated intervals. If the infant is being brought up by hand, the most careful attention should be paid, not merely to the milk or artificial food with which it is supplied, but also to the cleanliness of the vessels in which it is kept, and of the bottles or spoons in which it is given. If, notwithstanding every precaution, artificial feeding does not agree with the child, a wet-nurse must be procured. Attention to these primary rules of health sometimes has an almost magical influence in removing the complaint. At the same time the child's bowels should be regulated by a slight aperient; while a little of the glycerinum boracis, or a powder composed of borax and sugar, should be laid upon the tongue every hour or two. If ulcers have formed, they should be dusted with powdered alum, or touched with a strong solution of nitrate of silver or of sulphate of copper, or with the solid caustics. In cases arising from weakness caused by insufficient nourishment, two or three drops of brandy given in the food, four or five times a day, has often a marked effect in checking the disease. When the child begins to amend, a change of air will probably hasten its recovery.

When thrush occurs in old people, or as an accompaniment of some wasting disease, it is less easy to destroy the microscopic fungus, and to prevent its reproduction. Still much may be done to regulate the *primæ viæ*, to support the powers of nature, and to arrest the spread of the aphthous patches. For this purpose, Sir William Jenner recommends a lotion of sulphite of soda (℥j to the ℥j of water). It should be applied frequently with a camel's-hair brush, or the mouth should be rinsed with it. A weak solution of carbolic acid may be used in the same way; or a solution of sulphurous acid, in the proportion of one part of the acid to six of water.

W. Fairlie Clarke.

**THYMUS GLAND, Diseases of.**—Synon.: Fr. *Maladies du Thymus*; Ger. *Krankheiten der Thymusdrüse.*

In consequence of the atrophy of this organ in early life, little notice has been taken of it, either in its healthy state or when affected by disease.

According to the researches of Mr. Simon, the thymus gland reaches maturity in the child at the age of two years; it remains more or less perfect up to eight to twelve years; then it rapidly decreases in size, the glandular substance becoming converted into fat; and at the age of twenty years there is no trace of the organ left. At birth its weight is in proportion to the weight of the child. Taking 22 grs. to the lb. to be the usual proportion, 100 to 200 grains will be the weight of the gland at birth. From investigations made on young and hybernating animals, it appears that the greater the ratio of respiratory and muscular activity, the speedier is the decline of the gland. Consequently Mr. Simon thinks 'the thymus fulfils its use as a sinking fund of movement in the service of respiration.'

Summary of Diseases.—Instances both of excessive growth, and of prolonged existence of the thymus have been reported. A list of such cases was published by the late Mr. Alexander Bruce. In a healthy boy, aged fourteen, killed by an accident, the gland was found to weigh 620 grains; in a lunatic, aged twenty-one years, 300 grains; in a woman, aged twenty-nine years, 57 grains; in another woman, aged forty years, 30 grains. Krause mentions three cases, aged twenty-five, twenty-five, and twenty years, wherein the glands weighed respectively 292, 380, and 356 grains.

The actual diseases of the thymus gland which have been recorded are:—(1) Inflammation, followed by suppuration. In one such instance the abscess burst into the trachea. Syphilis has been stated to be a cause of embryonic inflammation of the gland. (2) Fatty degeneration of the gland. (3) Tubercular deposit in the gland. (4) Malignant disease. (5) Enlargement of the gland in leucocythæmia, and in (6) lymphadenoma. (7)

Calculi have been found imbedded in the gland-substance.

Cases have been reported of children dying from suffocation, with no other cause assigned for their death than pressure on the trachea from an enlarged thymus gland. Considering the position of the gland, between the sternum and the windpipe, and the small power of resistance possessed by the rings of the trachea during infantile life, an enlarged thymus may be a possible cause of suffocation.

In connection with an enlargement of the gland, a respiratory affection called 'thymic asthma' has been recognised. It is also named after two physicians, 'Kopp's,' or 'Millar's asthma'; but the majority of writers on diseases of children deny the existence of such a malady.

PUGIN THORNTON.

**THYROID GLAND, Diseases of.** SYNON.: Fr. *Maladies de la Glande thyréoïde*; Ger. *Krankheiten der Schilddrüse.*

Goître is the most common affection of the thyroid; and associated with it, but as a less prevalent disease, is exophthalmic goître. *See* GOÎTRE; and EXOPHTHALMIC GOÎTRE.

The diseases of the thyroid gland other than goître are rare. They comprise:—1. **Acute Inflammation** or thyroiditis. 2. **Hydatid cysts.** 3. **Calcareous deposit** in the gland. 4. **Cancer.** 5. **Sarcoma.** Fatty degeneration of the thyroid is of doubtful occurrence. Enlargement of the gland occasionally occurs in leucocythæmia, and in lymphadenoma. The gland is sometimes absent, or an accessory lobe may be present. It may degenerate in old people. The following affections alone require brief notice.

1. **Acute Inflammation.**—SYNON.: Thyroiditis.—This disease occurs in three forms:—(*a*) *idiopathic*; (*b*) *metastatic*; and (*c*) *traumatic.*

(*a*) *Idiopathic* thyroiditis is the rarest of these forms of inflammation. It chiefly attacks young people, and is generally due to sudden changes of temperature.

(*b*) *Metastatic* thyroiditis is rarely observed as a complication of acute infectious diseases, especially typhus, puerperal fever, and pyæmia. It has also been met with in pneumonia and bronchitis; and in connection with orchitis.

(*c*) *Traumatic* thyroiditis usually results in suppuration. Sphacelus of the gland is a possible result of active suppuration—a result not necessarily followed by any further mischief.

SYMPTOMS.—All three forms of thyroiditis commonly produce, amongst other symptoms, dyspnœa and dysphagia.

TREATMENT.—The treatment of inflammation of the thyroid gland consists in applying leeches and ice, and in using other antiphlogistic remedies. Deep-seated suppuration should be relieved by an early incision, otherwise the pus may find its way into the trachea or beneath the fascia. The best plan for opening the abscess is by means of the trochar and cannula.

2. **Hydatid cysts.**—Echinococci have, in a few cases, produced an enlargement of the thyroid gland. These hydatid cysts are difficult to diagnose from goitrous cysts until the fluid contents have been examined microscopically.



3. **Calculi.**—These bodies have been found imbedded in the substance of the thyroid. The writer has met with a specimen in which the calculus was the size of a walnut, and almost entirely took the place of the gland-substance of one lobe.

4. **Cancer.**—Primary cancer of the gland is a rare disease. It is met with in two forms—encephaloid and scirrhus. Cancer is not, it would appear, so commonly developed in a healthy gland as in one already affected by goitrous degeneration. Secondary cancer of the thyroid may also occur.

SYMPTOMS AND DIAGNOSIS.—The special symptoms caused by malignant disease of the thyroid are dyspnœa and dysphagia. The trachea and œsophagus may be involved in the disease. Very commonly one or both recurrent laryngeal nerves are included in an extension of the growth, and sometimes also the large vessels and nerves of the neck. Cancerous disease of the thyroid is probably present when there is a rapid enlargement of the gland, followed in an early stage by duskiness of the skin over the most prominent parts of the swelling. Superficial ulceration at a later date, often accompanied by hæmorrhage, and the general condition of the patient, will render the diagnosis clearer.

TREATMENT.—The only available treatment is entire removal of the gland, and this, to be of service, must be carried out at an early stage of the disease.

5. **Sarcoma.**—Sarcoma may be developed in the substance of a healthy thyroid gland, or in one already affected by goitrous disease. Thyroid sarcoma is, according to Lücke of Strasburg, rapid in its growth, not exceeding a year in duration.

An exceedingly interesting class of cases has been recognised within the last few years, in which tumours, growing simultaneously in various bones, such as the skull, vertebræ, and femur, and in the lungs and glands, have appeared, on examination, to be secondary to a simple adenomatous enlargement of the thyroid gland, and have presented microscopic characters precisely similar to that disease.

PUGIN THORNTON.

**TIC-DOULOUREUX** (Fr.).—SYNON.: Facial neuralgia; Prosopalgia.

DEFINITION.—Neuralgia of the trigeminal, trifacial, or fifth nerve.

One alone, more often two, but rarely all three divisions of the fifth nerve of one side may be coincidently the seat of neuralgia. It is less common for the third division to suffer than for the first and second. Tic has often been preceded or followed by neuralgia in other districts, especially in the occipital nerve.

ÆTIOLOGY.—Trigeminal neuralgia is rare in young children, but may occasionally occur in them, associated with decayed or irregular protrusion of the permanent teeth. In these circumstances, it is sometimes accompanied by epileptic convulsions. In its migraine shape, it almost always attacks the sufferer at some time during the period of bodily development. According to the late Dr. Anstie, the middle period of life is not fruitful in *first attacks* of trigeminal neuralgia

but, given a declared neuralgic tendency, the wear and tear of this stage tends much to recall it. In women utero-gestation, the exhaustion from hæmorrhage at parturition, menorrhagia, or over-suckling, as well as the sexual changes in middle life, are especially prone to reproduce facial neuralgia. It is, however, in the period of degeneration that the worst and most intractable examples occur.

The term 'brow ague' is still frequently applied to a neuralgia of the first division of the trigeminal, which cannot be referred to a malarious origin. Formerly, when malarious fevers were rife in this country, such an affection was, doubtless, of common occurrence; but at the present day, owing to drainage and cultivation, it is rare for this cause to be in operation. Cases do, however, occur, and these may usually be recognised by regular periodicity in the attacks of pain, a semi-algide condition of the system, and the rapid and effectual influence of quinine. Cold wind, especially with a moist atmosphere, has an undoubted influence in starting neuralgia of the fifth nerve, the unprotected condition of the face explaining probably its peculiar liability to be so attacked. There appears reason to think, however, that when damp with cold excites an attack of neuralgia, there must be at the same time a peculiar condition of the system, or neuralgia of the fifth would be much more common in this climate than it is. Such a condition is probably of a rheumatic or gouty nature, and the cold seems to start a subacute neuritis in the sheath of the nerve. As regards general conditions predisposing to the affection, they are those common to neuralgia. *See* NEURALGIA.

Injury of the nerve; foreign bodies, irritating either this or some other nerve; morbid growths of bone, especially such as cause contraction of bony canals traversed by branches of the nerve; and syphilitic periostitis, may act as exciting causes of tic-douloureux. Or the immediate cause may be in the floor of the cranium, in the form of tumours or disease of bone or of membranes, aneurism, or abscess.

SYMPTOMS.—Some obscure feeling of discomfort may precede the outburst of actual pain, or this may occur suddenly and without warning in some part of the district supplied by the fifth nerve. There will be one or more foci from which the pain will seem to emanate in swift flashes, a dull aching remaining between whiles, of a very wearying character. Generally short-lived at first, the paroxysms of darting, burning, boring pain gradually increase in severity and duration. The patient sometimes cringes under the violence of the agony. When fairly pronounced there is a great tendency to the excitement of a paroxysm by the influence of such slight irritants as a current of air, a sudden noise, or the muscular movements concerned in speaking, laughing, chewing, blowing the nose, or coughing. The attack of tic may vary to any extent in degree and duration, from a short-lived paroxysm which never returns, to a disease of the most obstinate character, embittering, with more or less constantly repeated attacks, the whole of a long life. In such cases it has a tendency to remit during the course of severe intercurrent diseases.

When the *ophthalmic division* of the nerve is affected, it sometimes happens that the first notice of the attack is an exceeding soreness of some spot on the scalp, recognised only on brushing the hair, and this is followed some hours afterwards by pains in the branch of nerve distributed to this point. The pains are most marked and tenderness on pressure can generally be noted in one or more of the following places—the supra-orbital notch, at a point a little above the parietal eminence, in the upper eyelid, at the junction of the nasal bone with its cartilage, within the eyeball, or at the inner angle of the orbit. There is often lachrymation, with redness of the conjunctiva, and sometimes intolerance of light. There is sometimes so much tenderness that the patient cannot wear a hat, or even wash his forehead. Or he may be unable to blow his nose. If one or two hairs be drawn over this hyperæsthetic surface, it will be found that the tactile discrimination is diminished, as compared with the corresponding region of the opposite side. The pain is sometimes described as shooting in the upper eyelid, or going between the eyeball and the cavity of the orbit, extending thence over the brow, as though the forehead were being slit open. Pressure upon the parietal point will send a sort of heavy dull shock into the eye. To neuralgia of this division, in consequence of the pain being limited to one-half of the anterior aspect of the head, the term *hemicrania* has been applied, whence the *migraine* of the French, and the vernacular 'megrim.' The neuralgic affection constitutes, however, only a portion of the complex group of phenomena to which the term migraine is properly applicable, and which includes, besides, subjective sensations of dazzling lights or colours, often of a zig-zag shape, transient hemiopia, vertigo, unilateral numbness and tingling of extremities, impairment of speech, nausea, and vomiting. *See* MIGRAINE.

When the *superior maxillary division* is in fault, violent pain is experienced in the cheek-bone or jaw, or in both, points of tenderness being found at the site of emergence of the infra-orbital nerve, over the malar bone, or on the gum of the upper jaw. The attacks of pain are sometimes accompanied by profuse watery secretion from the nasal and buccal mucous membranes. There may be swelling and acute sensitiveness of the lip and nostril, the slightest contact with which causes pain to shoot widely in various directions, sometimes appearing to affect distant parts of the body. Acute pain may also occur in the parotid gland, accompanied by a great flow of saliva, and also in the teeth.

When the *third division* is attacked, points of intensity may be found on the temple, a little in front of the ear, at the place of exit of the inferior dental nerve, at the side of the tip of the tongue, or more rarely in the lower lip. The writer has under his care two ladies past middle life, who are afflicted with neuralgia of this division. In one the pains attack both sides of the lower jaw and the under surface of both borders of the tongue. They occur in plunges of agony, which cause her to utter a kind of shrieking groan, and the head is jerked convulsively. They are brought on by chewing, swallowing, and even by speaking. Taste is not affected. In the other case the pain is entirely localised

in the left side of the tongue-tip, but here at times it is so intense that the patient rolls on the floor in agony. There is slight tenderness on pressure, but no painful dartings occur at the point of emergence of the inferior dental nerve. To cases of this kind marked by lightning-like seizures of exquisite character, and accompanied by spasmodic movements of the facial muscles, the term *epileptiform neuralgia* is sometimes applied. Hereditary tendency to insanity often accompanies this form. The lingual branch of the fifth is happily not so often affected as the other portions, for there is probably no form of neuralgia involving more exquisite suffering. When the auriculo-temporal division is affected, pain is located in the outer auditory meatus and temple. Many cases of so-called ear-ache are doubtless examples of neuralgia affecting this nerve.

There is a variety of trigeminal neuralgia which is known as *clavus hystericus*, and which occurs chiefly, but by no means solely, in females, and affects the period of bodily development. It is characterised by intense pain, limited to one or two small points (the parietal, or supra-orbital), and resembling the driving of a nail into the skull. It occurs most often in the anæmic, and has frequently been mistaken, with unfortunate results, for some inflammatory affection demanding depletory measures.

In severe tic-douloureux the facial muscles, those of the tongue, and even sometimes those rotating the head, may be spasmodically contracted by reflex action (*see* Trifacial Nerve, Diseases of). With supra-orbital neuralgia there may be blepharo-spasm or strabismus. The writer has lately seen a patient liable to neuralgia of the supra-orbital division for twenty years past, in whom, one year ago, the attack began to be attended with complete ptosis and external strabismus, from paralysis of the third nerve. A certain amount of weakness has continued between the attacks, but it is as an immediate sequel of the pain that the loss of power is most strongly marked. Two days after the cessation of the pain the eyelid can be raised fairly well and the eyeball moved, though never quite freely. Some degree of vaso-motor paralysis is shown by the reddening and heightened temperature of the face and swelling of the veins, which occur unilaterally during the paroxysms of pain, as well as by the soreness of skin, indicating probably a temporary congestion which remains behind. To the same cause must be referred the extreme redness of the conjunctivæ and mucous membrane of the nostrils, with increased lachrymation and flow of nasal and buccal secretion, often observed in this form of neuralgia. The hair is very liable to be changed in colour about the seat of pain. There may be a permanent blanching, as of the greater part of an eyebrow or a small tuft upon the head, or the change may be a fluctuating one, the colour returning during the intermissions of the disease. Individual hairs in the district of the affected nerve may be hypertrophied, or the converse may happen; and during the persistence of attacks the hair may become brittle and fall out, to return, however, when the neuralgia subsides. Anstie describes a state of thickening, the result of subacute inflammation, in the periosteum of bone and in fibrous fasciæ in the neighbourhood of the painful points of neuralgic nerves. Pressure on these swellings may not merely excite pains in the affected branches, but send a powerful reflex influence through the cord to distant organs, causing vomiting, or affecting the action of the heart. The skin is apt to grow coarse, and patches of pigment to occur in the painful situations. In neuralgia of the second and third divisions the corresponding half of the tongue is sometimes seen to be covered with fur from overgrowth of epithelium, and this even when the process of mastication has taken place equally on each side; or there may be salivation severe enough to cause a suspicion of mercurial action, but which may be distinguished by its being unilateral. Acute inflammation of the skin, in the form of herpes or of erysipelas, not unfrequently attends neuralgia of the fifth, especially its first division; and the eyeball itself may become in similar circumstances the seat of serious inflammatory action in one or other of its tissues. There may be a profuse and extensive eruption of herpes, leaving cicatrices which suggest confluent small-pox. In such a case neuralgic pains may cease during the eruption, to recur with great violence whilst this is scabbing. Acute glaucoma is attended by symptoms which appear to refer it to trophic changes consequent on neuralgia of the ophthalmic division of the fifth. There appears reason to think that recurrent iritis may sometimes be due to neuralgia or some kindred affection of the same division. Common sensation is frequently blunted during and after paroxysms of tic, but occasionally there will be so much and such persistent hyperæsthesia of the skin, that the patient cannot bear the face to be washed. In epileptiform tic the sufferer will often be observed to rub violently with a handkerchief the part of the face affected; but, on the other hand, there are cases in which not even the touch of a light bonnet can be borne, so exquisitely sensitive is a portion of the scalp. A touch with the finger upon this locality will sometimes cause the patient to fall to the ground.

Diagnosis.—The paroxysmal character of the pains, coupled with the tenderness on pressing various points, sufficiently indicate tic-douloureux. The only condition with which it is at all easily confounded is the painful anæsthesia which is apt to be an early symptom of the encroachment of a tumour upon, or some other destructive lesion of, the trunk of the nerve within the cranium (*see* Trifacial Nerve, Diseases of). The presence of pain will distinguish the spasmodic contractions of the facial muscles secondary to the neuralgia from mimetic spasm proper. There is no doubt that neuralgia about the forehead is often mistaken for some inflammatory intracranial mischief, and this is peculiarly liable to happen where either ptosis or strabismus forms part of the symptoms. Careful examination, bearing in mind the points of diagnosis described, ought to obviate error. Still more important is it to avoid the error of ascribing to this form of neuralgia the pain occasioned by the growth of intracranial tumour (*see* Brain, Tumours of). It must be remembered, too, that pus in the antrum may occasion neuralgic symptoms. A most fruitful source of tri-

geminal neuralgia is caries of the teeth. The first care in a case should be to have the state of the teeth accurately investigated, and faulty teeth removed or otherwise treated. It may happen that a tooth betraying no outward signs of decay is carious internally, and may thus easily escape recognition

Prognosis and Duration.—Tic-douloureux occurring in youth and apparently as an accident of exposure, or as a result of faulty teeth, may never recur. It is perhaps more common, however, for repetitions of the attack to take place, alternating, it may be, with neuralgia in other quarters. Tic is not unfrequently liable to recur, especially under circumstances of depression, through a whole lifetime, but it may never have the character of extreme severity. In certain few cases, however, it is not only obstinate, but of terrible violence, the patient being incapacitated through many years by the constantly recurring affection. The pain has been in some cases violent enough to destroy life. As a rule, however, the disease, however severe the agony entailed by it, does not seem of itself to shorten the duration of the life which it fills with suffering.

Treatment.—As in neuralgia generally, the treatment is partly constitutional and partly local and palliative of suffering (*see* Neuralgia). The hypodermic injection of morphia holds the first place as a means of relief. It is well to begin with a small dose, say $\frac{1}{10}$th grain, and repeat it in the course of twelve hours if necessary. If the doses employed can be kept at a moderate amount, there will not be much fear of opium-hunger being created, and they can be discontinued without difficulty as the disorder subsides. The injection is quite as efficacious when made in the arm as in the face. Blisters are often of great service. A small one should be applied over the branches of the cervico-occipital nerve at the nape of the neck, and repeated if necessary. The constant voltaic current is sometimes useful. A sufficient number of cells (from four to eight or ten) should be employed to give such a current as causes the negative pole to impart a very distinct burning sensation. The circulation should never be abruptly opened by the removal of the rheophore, but on applying and when leaving off a gradual heightening or lowering of the strength should take place, in order to avoid a shock. The rheophores should be fitted with sponges well moistened with salt and water, or with carbons plunged for a minute or two in hot water. The application may be continued for five or ten minutes at a time, and be repeated several times daily. In some cases of tic a combination of 20 or 30 grains of chloride of ammonium with five drops of nepenthe, taken two or three times a day, is singularly efficacious.

Croton chloral—2 to 4 grains in a pill taken every two hours for a few times—may be sometimes employed with advantage. So, also, the tincture of gelsemium sempervirens, given in doses of 15 to 20 minims every two hours, till relief is obtained. The hydrate of chloral in a dose of 20 grains will sometimes be of great service, if the pain is not very severe, in procuring a natural kind of sleep from which the patient wakes relieved. If, however, the pain be severe, chloral is useless. It is important not to confound the epithelial overgrowth of the tongue, which so commonly occurs in tic, with the ordinary furring from digestive difficulties which is supposed to indicate a necessity for purgatives. It will be observed that it only affects a lateral half.

In two cases of epileptiform tic of from seven to ten years' duration, which had resisted all treatment, and incapacitated the sufferers from earning their livelihood, the writer had two out of the three divisions of the trigeminal stretched, with most satisfactory results. In one case five months, in the other about twelve months have elapsed since the operation, without return of pain. It appears to be essential that not only the central end of the nerve should be pulled upon with considerable force, but also the peripheral portion. A considerable amount of cutaneous anæsthesia ought to follow the operation, though it usually does not last more than a few days. *See* Nerves, Diseases of.

T. Buzzard.

**TIN, Poisoning by.**—Synon.: Fr. *Empoisonnement par l'Étain*; Ger. *Zinnvergiftung.*

The importance of tin as a toxic agent has only recently been recognised; for although attention was drawn nearly a century ago to the possible danger attending the use of tinned vessels for culinary purposes, the danger was supposed to be due simply to the contamination of the metal with arsenic. Subsequently alarm was excited in consequence of the employment of alloys of tin for the storage of tinned preserved articles of food, such as meat, vegetables, and fruits; but here again the danger has been assigned to the lead with which the tin is alloyed, a lead-tin alloy being used for the construction of the capsules employed. Very recently, however, attention has been directed to the tin with which tinned foods are almost invariably contaminated, as itself presenting a source of danger to the consumer. It is known that the soluble salts of tin, met with in commerce as *Dyer's salt*, *pink salt*, &c., are poisonous; and experiments on animals show that even the insoluble hydrated oxides of tin are fatally poisonous, the oxides being no doubt dissolved in the alimentary fluids, tin having been detected after death in such cases in the liver and other solid viscera. Certain kinds of sugar recently brought into commerce are prepared by a process which introduces tin to the extent of from one-fourth to one-third of a grain per lb. of sugar into the manufactured article; and it is at present a moot point whether these sugars are innocuous or deleterious.

Anatomical Characters.—The *post-mortem* appearances in fatal poisoning by tin are those of the mineral irritants. The cases observed have been too rare to be spoken of otherwise than generally. *See* Poisoning.

Symptoms.—Of these but little is known. Concentrated solutions of stannous chloride and of stannic chloride—the lower and higher chlorides respectively of the metal—are known to act as irritant poisons. Neurotic symptoms are also manifested, so that tin-salts do not appear to

act simply as irritants. In large doses the chlorides produce fatal results. Probably the toxic results are heightened by the free hydrochloric acid invariably present in the commercial solutions of stannous and stannic chlorides.

TREATMENT.—The treatment to be employed is that for mineral acids. *See* POISONING.

THOMAS STEVENSON.

**TINEA** (*tinea*, a moth-worm).—SYNON.: Fr. *Teigne*; Ger. *Flechte*; *Tinea*.

DEFINITION.—A class of diseases of the skin, due to the presence of vegetable parasites in the integumentary structures. The term is also employed as a generic name for the organisms themselves.

VARIETIES.—The varieties of tinea generally distinguished are *Tinea tonsurans*; *Tinea kerion*; *Tinea circinata*; *Tinea sycosis*; *Tinea ungium*; *Tinea versicolor*; and *Tinea favosa*. The first five are varieties caused by the same fungus, and are included under the term *Tinea trichophytina*. Tinea favosa is described in the article FAVUS; tinea versicolor in the article PHYTOSIS VERSICOLOR; and tinea sycosis is also referred to under the heading SYCOSIS.

1. **Tinea tonsurans.**—SYNON.: Ringworm of the hairy scalp; *porrigo scutulata* and *herpes tondens* of old writers.

DESCRIPTION.—This is a chronic disease of the scalp, resulting from an attack on the epithelial tissues of a fungus called *trichophyton tonsurans*. The characteristic lesion is a textural alteration of the hairs, due to the growth of the fungus, which causes them to become lustreless, opaque, dry, swollen, and brittle, and to break off close to the scalp, as though nibbled away, at the same time that they are surrounded and invaded by fungus-elements. This change takes place over more or less circular areas, which are of varying size, from a threepenny-piece to that of the palm of the hand, and are the seat of fine, white, meal-like desquamation. The fungus, once implanted upon the surface, leads to the changes detailed in the article EPIPHYTIC SKIN-DISEASES. There may be many spots of disease, or only one. Clinically it is important to be aware that the disease may vary in appearance from the typical characters above described. The patch of tinea tonsurans may not be circular but irregular, which may be due to the coalescence of two or more patches. In strumous subjects a certain amount of pus may be produced at the seat of mischief; and this, together with the hairs, may be matted together into a semi-crust, in which the diseased hairs of ringworm are not very recognisable at first. Lastly, in chronic cases of tinea tonsurans, there may be only a diseased hair here and there amongst the healthy ones, and these are very liable to be overlooked. To be made aware of these variations in appearance is, however, to greatly facilitate the diagnosis. Whenever the growth of hairs seems to be interfered with in a patchy form, and there is desquamation, a careful examination should always be made for the parasite in the hairs. Tinea tonsurans (of the scalp) often co-exists with T. circinata (of the general surface), and the latter may extend to the scalp and there become T. tonsurans. Thus these two varieties are essentially the same in nature, the only difference being, that in the one case the fungus attacks a hairy part, and causes a peculiar change in the hairs; and in the other it grows on parts where any implication of hairs is a secondary feature.

In examining a hair, it should be soaked for some time in diluted liquor potassæ, placed on the slide, and covered by thin glass in the usual way; and then a little pressure should be made, so as to flatten the piece of hair to separate its component fibres, by getting as it were a thinner section, to bring the fungus more readily into view. The fungus, the *trichophyton tonsurans*, as usually seen, consists almost entirely of *conidia*, or those reproductive bodies commonly called spores. They are round, ·003 to ·007 mm. long, by ·003 to ·004 mm. broad (equivalent to from $\frac{1}{8000}$ to $\frac{1}{3000}$ in.) very uniform in size, however, in any particular case; nucleated; sometimes constricted; and very abundant about the roots of the hair. The *mycelial* filaments, when seen, are few, jointed, somewhat undulated, and with interior granules. The fungus attacks both the hairs and other epithelial structures.

DIAGNOSIS.—The diagnosis of tinea tonsurans is at once made by the presence of the short, texturally altered, and broken-off hairs; and attention should be given to this point, and not, as is too often done, to the mere 'eruptive' phase of the complaint.

TREATMENT.—The treatment is most disappointing, and it is difficult to enforce with any great degree of success, except in cases under the immediate eye of the medical attendant. It is needless to enter here into detail at length, and the following is a summary of the treatment of ringworm, as applicable to the majority of cases. There are three indications. *First*, we must improve the general nutritive tone of those attacked, for thereby the fungus finds a less favourable soil for growth. *Secondly*, we have to get rid of the fungus; and this is effected in two ways, partly by removing as far as possible all diseased hairs by epilation, and partly by bringing parasiticides in contact with the diseased structures. And, *thirdly*, it is necessary to secure an entirely new growth of hair, since, practically, hairs once attacked by the fungus never return to a healthy condition; and the occurrence of this latter desideratum is favoured in proportion as epilation is complete, and is accelerated by stimulation after the removal of the diseased hairs.

The *first* indication above stated is effected by the administration of good food; by placing the patient under the influence of good hygienic conditions; by prescribing cod-liver oil, iron, quinine, or arsenic, according as the constitutional state is one of a strumous or lymphatic nature, or is attended by anæmia, debility, or the like. Fatty substances of all kinds, when they can be digested, are, as a rule, to be taken by children suffering from severe ringworm.

As regards the *second* indication, before epilation or parasiticides are used, the hair should be cleared away from off and around the diseased surfaces. If there are many places about the scalp, it is well to cut all the hair off. It is best removed by the scissors: if the scalp be shaven, it is

mostly excoriated and made tender, so that strong remedies cannot be so well applied. The preferable plan is to cut the hair as close as possible to the scalp with scissors, and to repeat the operation every few days. When the hair has been removed, the diseased surfaces appear as more or less well-defined circular areas or patches, which are darker than the healthy scalp, covered by scales, and studded by hairs, which are swollen, thickened, lustreless, and brittle. Epilation is now to be proceeded with. The nurse, mother, or medical man, whoever it may be, should take a pair of ciliary forceps, and clear away the hairs as far as practicable, over an area of an inch or more in diameter at a sitting; many hairs break off, but some come away whole, and if they do break away, more decided access is given to the follicles for parasiticides. All patches should be epilated, the operation being repeated over the same areas from time to time, as the diseased hairs grow up. After epilation, two or three courses may be adopted. The part may be blistered, or parasiticides of a non-vesicating character—and their name is legion—may be applied, or a plan combining the use of both means may be adopted. Repeated blistering with acetic acid, or acetum cantharides, may be resorted to, but perhaps the mixed course is the best. It is a good plan to blister occasionally or once a week, going over the same parts two or three or more times after each blistering, allowing time to get the scab off, then rubbing in freely a parasiticide for several days, and then re-applying the blister. The best parasiticides are the iodine liniment, sulphur compounds, mercurials, tar, creasote, and carbolic acid, which may be variously combined in strength according to the age of the child. The ointment form is preferable, and it should be thoroughly inuncted night and morning. Very small inveterate patches may be treated by croton oil liniment, to excite the formation of pustules round each hair, or better still artificial kerion. The hair is thus loosened and got rid of. The number of remedies for ringworm is legion; but the particular remedy used is not so important, as that it be used vigorously, with epilation, till every vestige of a diseased hair has disappeared. In fact, the entire absence of any short, thick, brittle stubs, which may be broken off quite in the follicles, and the springing up of fine, downy, silky hairs, are the only real proof that a scalp ringworm is cured. During this treatment the head should be well washed every day, and light linen or silk caps must be worn. The individual affected is to be regarded as capable of spreading the disease from person to person, or of conveying ringworm of the surface, tinea circinata, to adults. Change of air is always desirable.

The *third* indication, namely, the promotion of the re-growth of the hair, is secured by the use of some stimulating wash. The following is a good one:—Tincture of lytta 6 drachms; distilled vinegar, 2 ounces; spirit of rosemary, 2 ounces; glycerine, 2 drachms; and 6 ounces of rose-water; to be well sponged into the roots of the hair night and morning.

2. **Tinea kerion.**—Description.—This is not a common disease. It is a modification of tinea tonsurans in which each separate hair-follicle is swollen and prominent, and exudes a puriform fluid like mistletoe juice. The joint result of the swelling of the many hair-follicles together is the production of a raised boggy circular swelling, studded over with minute orifices, discharging muciform fluid. In some cases, it would seem as if subcutaneous formation of pus were about to take place. The hairs lie loose in the follicles, having been detached from the follicular linings by the exudation; and they are readily pulled away, and indeed often fall out spontaneously. If they remain in the follicle for any time, they are apt to get very brittle. This disease is idiopathic; or it may be set up by the use of irritant remedies to the scalp, by which the follicles are inflamed.

Treatment.—This disease cures itself, so to speak. The hairs, being loose in the follicles, are readily removed therefrom, and with them the fungus; or so little of it is left behind that the mildest parasiticides alone are required. Epilation, in fact, is both easy and immediately successful. The writer was the first to demonstrate the parasitic nature of the disease, and his experience teaches him that, as a rule, all that is needed is the removal of the hairs, and the use of soothing remedies, such as liquor plumbi ointment.

3. **Tinea circinata.**—Synon.: Ringworm of the surface.—Description.—As stated above, this disease is produced by the same fungus that is present in tinea tonsurans, but it is an affection of non-hairy parts. It generally begins by a small scurfy spot, or rarely a minute red patch with a vesicular edge. In either case the fully developed disease consists of one or more well-defined circular patches, the bounding edge being red, raised, and vesicular; whilst the central area is much paler, and is the seat of branny desquamation. If an examination be made of scrapings from the surface of the patch, the fungus will be detected, and in its mycelial form chiefly. Tinea circinata is common about the forehead, cheek, chin, and back of the neck, but also occurs on other parts of the body. It often co-exists with tinea tonsurans; and it can give rise to the latter by transmission to the scalp of its fungus-elements, or by its extension from the face or neck to hairy parts of the scalp.

In some cases, especially in persons who perspire, and in hot weather—that is to say, under the combined influence of heat and moisture, and consequently in hot climates—ringworm of the surface may be very severe and extensive. The circular patches are very large, with well-defined edges, spreading over various regions of the body. The common seat is the fork of the thigh, to which it may be localised, festooning downwards some little way. This is the *eczema marginatum* of Hebra, an eruption often seen in England. In other cases there may be rings or patches, still with papular or vesicular edges and desquamating centres, scattered over the buttocks, the thighs, about the front of the chest, the axillæ, or the neck and face; two, three, or more places being affected at a time. This condition is common in China, India, and other hot climates, and to it the terms 'Dhobie's' and 'washerwoman's itch,' 'Indian ringworm,' and 'Chinese ringworm,' are applied. But these locally-named varieties are all modifi-

cations of common tinea circinata; and the writer has seen equally severe cases in England in very hot seasons.

Diagnosis.—The diagnosis is made certain by microscopic examination, and the detection thereby of the fungus. All circular well-defined patches of skin-disease, with papular or vesicular edges and paler desquamating centres, should be examined for a parasitic cause.

Treatment.—Tinea circinata is usually easily cured by the inunction of any of the parasiticides already mentioned; but such treatment may be preceded by the application of some mild vesicant, as acetic acid or blistering fluid, to remove the epidermic layers in which the fungus mostly flourishes. In some cases the disease is very obstinate, but most will yield to the free application of a hyposulphite of soda lotion, ℥ss to ℥ij of water; or to repeated applications of gunpowder or goa powder made into a paste with vinegar.

4. **Tinea sycosis.**—Tinea sycosis is also produced by the attack of the trichophyton tonsurans upon the hairy parts of the face, namely, the whiskers, or more commonly the beard. It is fully described under its own heading. *See* Sycosis.

5. **Tinea versicolor.**—This disease is characterised by the presence of fawn-coloured, more or less circular, patches, slightly raised, itchy, and the seat of branny desquamation. The fungus is the *Microsporon furfur*, composed of conidia of a round shape, ·0008 to ·002 mm. in diameter, collected together into characteristic heaps, connected by a network of thick wavy and branched threads. In examining for the fungus a very small piece and a very thin layer of scale must be taken, and it must be rendered very transparent by potash, and gently pressed out between the glasses. For a description of the disease *see* Phytosis Versicolor.

**Onychomykosis.** — Definition. — Parasitic disease of the nails.

Description.—Occasionally the trichophyton, and very rarely, the achorion, will attack the nail, sending mycelial threads through the nail-substance, and rendering the nail opaque, thickened, and brittle. Other causes produce thickened, opaque, brittle nails, such as psoriasis, syphilis, general debility, general eczema, lichen ruber; but in parasitic disease only a single, or perhaps two or three nails are affected, the nails of the feet escaping almost invariably. Hence, in all cases where only one or two nails are opaque, brittle, and thickened, a careful examination of the nail-substance should be made for fungus-elements. Onychomykosis may occur with tinea circinata, the latter, in fact, investing the nail, or it may be derived by contact with tinea tonsurans, as in the case of those who attend to ringworm cases.

Treatment.—The treatment consists in scraping away the nail-substance and soaking the parts continuously in hyposulphite of soda, sulphurous acid lotion, or some approved parasiticide.

Tilbury Fox.[1]

**TINKLING, METALLIC.**—A sound of a peculiar quality, which the name sufficiently defines, occasionally heard on auscultation in connection with cavities in the chest. *See* Physical Examination.

**TINNITUS** (Lat.).—Synon.: Fr. *Bourdonnement d'Oreilles*; Ger. *Summen*; *Klingen*.—This term, which is commonly used when speaking of noises in the ears, is a frequent symptom in many diseases of the external, middle, and inner ear. It is usually present in all those conditions where there is undue pressure on the labyrinth; for instance, when there is pressure on the tympanic membrane from cerumen, imperfect entrance of air into the tympanum, due to obstruction of the Eustachian tube, or effusion within the tympanic cavity. It accompanies most inflammatory diseases of the external or middle ear; follows injuries to the tympanic membrane, and blows on the head or ear; may occur in aneurism at the base of the skull; and is a prominent symptom in all nervous affections of the auditory apparatus, as well as in many states of disordered hearing where the ear is healthy. So infinite are the degrees and variations in this symptom that there is probably no known sound to which it has not been compared by patients. When tinnitus is due to some curable local cause, the symptom rapidly disappears with its removal. When, however, it accompanies deafness in nervous affections, it is often the more troublesome symptom of the two, and the less amenable to treatment. Strychnia is the most useful tonic in ear-affections, and quinine the least suitable, as this drug exercises a distinctly injurious effect, if taken in large doses. *See* Ear, Diseases of; Hearing, Disorders of; and Vertigo.

W. B. Dalby.

**TITUBATION** (*titubo*, I stagger).—A term for staggering or stumbling gait. *See* Cerebellum, Diseases of; and Vertigo.

**TOBACCO, Poisoning by.**—Synon.: Fr. *Empoissonement par le Tabac*; Ger. *Tabakvergiftung*.—The minor effects of tobacco-poisoning—nausea, depression, vomiting, vertigo—are well known to the incipient smoker. Fatal poisoning by tobacco rarely occurs, except through its ignorant administration by mouth or rectum. Cases of nicotine-poisoning are still more rare, this, the volatile active alkaloid of tobacco, not being readily procurable.

Anatomical Characters.—After death from tobacco-poisoning the organs and tissues have a tobacco-like odour, and the odour of nicotine becomes more pronounced on treating them with liquor potassæ. Turgescence of the brain has been described; but, beyond the odour, there is nothing diagnostic in the appearances.

Symptoms.—When a strong decoction of tobacco or snuff is administered, either by mouth or rectum, very speedily—usually in about five minutes—the patient is seized with vertigo, acute abdominal pain, nausea, and vomiting. The skin is pallid and bathed in perspiration. Stupor supervenes, with partial or general convulsions, and stertorous respiration; and death may result in fifteen or twenty minutes, preceded by dilatation and insensibility of the pupils. When the alkaloid, nicotine, is swallowed, insensibility supervenes almost immediately; the

[1] Revised by Dr. T. Colcott Fox.

pupils are widely dilated; respiration is speedily suspended; and the patient dies in three or four minutes.

Diagnosis. — The *odour*, coupled with the above-described symptoms, would leave no doubt as to the nature of the case. Usually there is a history of administration.

Prognosis.—The prognosis is in all cases unfavourable. *Fatal Dose.*—Thirty grains of tobacco are said to have proved fatal. A drop or two of nicotine would doubtless prove fatal.

Treatment.—The treatment of poisoning by tobacco consists in the exhibition of emetics, followed by tannin freely in any form to render the alkaloid insoluble. Strong tea, coffee, and stimulants should also be administered. Iodine, dissolved with iodide of potassium, has been recommended; but is probably of little efficacy, and is undoubtedly irritating to the stomach. Twenty to thirty minims of tincture of nux vomica may be given, and repeated at intervals; or, better, a hypodermic injection of $\frac{1}{25}$-grain of the nitrate or other soluble salt of strychnia may be administered.

Thomas Stevenson.

**TONE, Want of.**—This expression, although commonly employed in a somewhat loose and unscientific manner, is sufficiently understood in the main. To appreciate its meaning, it is first necessary to enquire what tone is. In the widest sense of the term, a person may be described as being *in tone* when his several organs individually discharge their functions in a perfect manner, and act harmoniously as a whole, just as a violin is said to be *in tune* when melody can be educed by striking its individual strings. More correctly, tone is applied to a condition of the muscular system, as signifying that state of tension in which voluntary muscular efforts can be produced and continued with a healthy and pleasurable feeling; and also to muscular organs, to indicate a certain degree or power of contraction of their walls.

Ætiology and Pathology.—Various factors combine to produce and maintain muscular tone. First, this state is dependent on a proper supply of *nervous energy*; secondly, *nourishment and oxygen* must be furnished in abundance; thirdly, the *products of waste* must be thoroughly *removed* from the system; and fourthly the *work* required of the muscular tissue must *not be excessive*, that is, a certain amount of rest must be afforded to it.

Want of muscular tone results, then, from failure of any of these circumstances.

1. *Nervous failure.*—Whatever view may be taken of the nature of nervous and muscular force, modern research has shown that they are intimately connected with each other. If the nerve-supply be cut off, muscles waste; and *vice versâ*, if the muscles remain unemployed, their nerve-centres suffer. The effect of nervous disease or disorder in producing loss of muscular tone is illustrated by such neuroses as hysteria and epilepsy, by some forms of mental disease, and by the large but indefinite class of cases known as 'nervous debility,' of which mental strain, anxiety, sexual excess, and alcoholism are frequently the exciting causes. It is in these cases that we derive special benefit from what are called 'nervine tonics,' such as strychnia, the phosphates, and cod-liver oil.

2. *Failure of nutrition.*—Deficiency of the blood-supply immediately lowers muscular activity, in consequence of interference both with the nutrient and the oxygenating processes. It is on this account that want of tone is found in anæmia, in convalescence from acute diseases, and to a certain extent even in chronic dyspepsia. Want of oxygen and impurity of the atmosphere lead as distinctly to lassitude; and, if long continued, to lowering of muscular energy and loss of tone, as amongst the inhabitants of large towns, and in persons employed in close, ill-ventilated rooms.

3. *Retention of waste products.* — When muscles are called into action certain compounds are formed within them, which must be eliminated by being passed back into the circulation and excreted. The lungs, skin, kidneys, liver, and bowels must, therefore, discharge their functions properly to keep the muscular system in tone. We have here the explanation of a very common class of cases of want of tone. Many persons, either from choice or from necessity, habitually take an insufficient amount of active bodily exercise for the removal of the waste products from the muscular and other systems. In the former case this is the result of indulgence in abundant rich food, combined with lazy habits, confinement to warm 'relaxing' rooms, and the avoidance of 'bracing' exercise. In the latter case, the metabolic inactivity is referable to enforced confinement in sedentary employments, often of an exhausting kind, carried on perhaps in an impure atmosphere, or throwing a continuous strain upon one set of muscles, such as those involved in standing or sitting. Both these classes of cases also are met with chiefly in large towns, and they constitute a considerable proportion of the persons who 'require tonics.'

4. *Muscular exhaustion.*—Excessive muscular exercise leads to loss of tone; first, by interfering with nutrition, which is most active during rest; secondly, by wear and tear; and thirdly, in the case of hollow muscular organs, such as the intestines (the muscular walls of which have to resist internal pressure), by gradual exhaustion of muscular irritability from continuous excitement, or possibly even by overstretching and dislocation of the fibres. The first two forms of muscular atony are well illustrated by certain instances of cardiac exhaustion; the third form is met with not only in the alimentary canal, but in the bladder, in the blood-vessels, and indeed in all muscular tubes and ducts, when over-distended by solid, fluid, or gaseous contents.

5. *Combined causes.*—In many cases two or more of the causes mentioned under the preceding heads are combined, and give rise to want of tone or atony. Thus in that large class of cases of debility with which practitioners in large towns are familiar, and which especially includes young female subjects engaged in business, over-work, impure air, insufficient light, badly cooked or otherwise improper food, the constant strain of the muscles of the legs and

back without sufficient movement, and frequently many circumstances relating to the nervous system, are all combined. Again, the subjects of chronic nervous affections, such as epilepsy and hysteria, are too frequently over-fed, nursed in warm rooms, and spared every form of healthy exertion, with the result of producing a flabby, atonic state of system.

Symptoms.—Want of tone in the muscular system generally is characterised by a number of symptoms, which are all more or less ill-defined and difficult to describe, being chiefly of a negative and subjective kind. The chief of these are a peculiar feeling of want of muscular vigour; weakness, heaviness, and even aching of the limbs; languor, inability and unwillingness to undertake or to continue any kind of physical or mental exertion, and a desire to remain passive and undisturbed. This reacts upon the mind, causing depression of spirits, melancholy, and other subjective symptoms.

The symptoms of want of tone or atony of muscular organs vary greatly with the part affected. Thus atony of the stomach is characterised by a familiar form of dyspepsia, which is called 'atonic;' atony of the bowels is chiefly attended by constipation and flatulence; atony of the bladder is associated with retention of urine. Ulcers are said to 'want tone' when the healing process flags.

Treatment.—It will be gathered from the preceding remarks that want of tone, whether general or local, is a condition which calls for very different kinds of treatment, according to its cause. One of the principal reasons of the want of success which frequently attends attempts to restore tone to the system is failure on the part of the practitioner to appreciate this truth, and to discover and remove the cause or causes of the morbid state. Tonic drugs suggest themselves only too readily as the proper means to be employed; and so great is the number of remedies which go by this name, and so complex are the combinations in which they are now presented by the pharmacist, that recourse is often had to them before an accurate estimate has been made of the direction in which the system or the affected organ is really at fault, and hence injury, not benefit, results. These remarks apply both to loss of tone generally, and to atony of special organs. Thus it happens that the best tonic measure in one case may be rest, in another case exercise; in a third case food and stimulants may be urgently called for, in a fourth case lowering measures are essential at the commencement of treatment. Time is an equally important factor in the process of restoration to tone. This is especially true in the instances where rest is necessary; but even in the very opposite class of cases, where exercise is demanded, this must be carried on for a long time, being commenced with caution and slowly increased.

The details of tonic treatment are indicated in a special article (*see* Tonics). Here it need only be added that when the nervous elements are distinctly deficient in activity, strychnia, cinchona, phosphorus, and cod-liver oil appear to be specially indicated, whilst galvanism and massage may be useful. Alcoholic stimulants and iron are best adapted to cases in which nourishment and oxygenation have fallen below par. Dr. Weir Mitchell has lately shown how much may be done by systematic feeding in conjunction with the other means just indicated. When the activity of the organs is diminished from accumulation of waste products, we must have recourse to moderate cholagogue purgation, to such diuretics as digitalis, to diaphoretics, and especially to change of occupation and exercise of such a kind in an open healthy atmosphere as shall bring all the voluntary muscles into action, and stimulate if possible every bodily function. In the converse class of cases, where exhaustion is the result of over-exertion, we have, after removing the cause, to exhibit antispasmodic or even sedative drugs, such as belladonna and opium, which are especially useful in the first stage of atony of the stomach and alimentary canal, as well as in atony of the bladder.

William Bruce.

**TONGUE, The.**—Synon.: Fr. *La Langue*; Ger. *Die Zunge.*—Apart from its own particular diseases, which are described in a separate article (*see* Tongue, Diseases of), the tongue, as is familiarly recognised, gives important clinical indications regarding the morbid conditions of the general system, and of various local diseases, which it will be the object of this article to endeavour to point out in a systematic manner. To 'look at the tongue' is one of the first acts of 'physical examination' which every tyro in the medical profession performs; but there is much that is indefinite and uncertain in the ideas as to what this examination is intended for, and what information it affords.

Mode and Objects of Investigation.—In general terms it may be stated that we examine the tongue, for clinical purposes, with reference, first, to its *subjective sensations*; secondly, to its *movements*; and, thirdly, to the *objective characters* which it presents.

1. Its *subjective sensations* chiefly include ordinary tactile sensation and the sense of taste. In most cases we rely for information on these points upon the statements of patients: but under certain circumstances common sensibility may be tested experimentally by a suitable instrument; and taste, by applying different articles to the tongue with a brush, or in other ways (*see* Taste, Disorders of). Dr. Quain has called the attention of the writer to a peculiar sense of heat or burning, sometimes felt in the tongue, which seems to be associated with the gouty diathesis.

2. The *movements* of the tongue are studied by watching them directly, and by noticing any abnormal affection of speech or deglutition, arising from defect or disorder of these movements. A peculiar thickness of speech, or an inability to swallow properly, may result from this cause, and finally articulation and deglutition may become impossible. To examine the tongue directly as a motor organ, it should first be looked at while in the mouth, both at rest and when the patient moves it from side to side, or in other directions; then he should be directed to put it out, and to perform similar movements when the tongue is protruded. This mode of

investigation gives, in certain cases, important information.

3. The *objective examination* of the tongue in itself is of far more frequent application than the methods just considered, being indeed called for and ordinarily practised in every case, although it may not necessarily afford any positive information. No patient thinks his case properly investigated unless he is told to put out his tongue. The examination is usually carried out by inspection; but it may also be requisite, and very advantageous, to feel the tongue with the fingers. In looking at the organ, an endeavour should be made to inspect its entire upper surface, and for this purpose the patient should be directed to open the mouth, and protrude the tongue as far as possible, a good light being also needed for observing it. In some instances, as in infants and rebellious children, as the result of congenital malformations or wearing false teeth, in many low febrile cases, and in certain nervous diseases, the tongue must be examined while in the mouth, as the patient either cannot or will not put it out properly; for this purpose it is sometimes necessary to open the mouth rather forcibly, but with due care, and it may be desirable to employ some artificial light. For more minute information in certain cases it is requisite to scrape the surface of the organ, and to examine microscopically what is thus removed. The points to be noticed in the objective examination of the tongue are:—*a.* Its size and shape as a whole, as well as its point and margins. *b.* Its condition as to firmness or flabbiness. *c.* The colour of the mucous membrane. *d.* Whether the surface is normal, unusually smooth and glazed, furrowed, fissured, or otherwise altered. *e.* The condition of the papillæ, especially the fungiform papillæ. *f.* Whether the tongue is moist, sticky, or dry. *g.* The absence or presence of any fur on the dorsum of the organ; and, if present, its arrangement, thickness, colour, and other general characters, as well as in some cases its microscopic characters. It may be remarked that in connection with this examination of the tongue, it is often advantageous to notice the condition of the mouth generally, but especially of the gums and teeth, and of the lips. Further, the patient may afford information with regard to the objective conditions of the tongue, not coming immediately under the notice of the practitioner, such as whether it is much furred on waking in the morning, or if it is inclined to dryness.

It is requisite to offer a few remarks respecting *fur* on the tongue. This varies much in its extent, thickness, and appearances. It may cover the whole surface of the organ; or only its posterior or anterior part, one lateral half, or even a limited patch when due to local causes. The fur may be a mere film, or of considerable thickness. Its chief colours are white, whitish-yellow, yellow, yellowish-brown, brown, brownish-black, and black. It is either moist and easily separated; sticky and viscid; or dry, being then often cracked and peeling off. Under certain circumstances fur appears and disappears with great rapidity. Microscopically it is found to consist chiefly of epithelium-particles, either formed in excess, or accumulated upon the surface of the tongue from various causes. The particles are held together by saliva and mucus; and mixed with them are often the remains of food, or bacteroid growths, especially bacilli and micrococci. Yellow fur is supposed to be due to fatty degeneration of the epithelium, and then fatty particles are present. Blood or altered blood, and pigments are found in the brown and black furs. The increased production of epithelium, causing a fur, is due to hyperæmia of the tongue, dependent either upon the general condition of the patient, or upon direct or reflex irritation. There are serious conditions, however, in which the development of epithelium on the tongue is prevented, and so it is not furred, but becomes red and raw.

Clinical Indications.—In the following remarks it is intended to give a summary of the principal conditions and diseases in which the tongue affords useful information, and to indicate the main characters which it presents. Allowance must always be made for individual peculiarities in the shape or size, and in the appearances presented by this organ; for the effects of certain habits, such as excessive smoking, or chewing tobacco and other materials; for changes in colour due to taking iron or other medicines; and for any local irritation. Moreover, most people, but especially those who sleep with the mouth open, have a more or less furred tongue in the morning, which is of no special importance, or it may tend to dryness; while in some individuals its surface presents constantly a thick fur, without evident disturbance of any organ, appetite being excellent, and the digestive functions performed in a most satisfactory manner. On the other hand, a perfectly clean and healthy-looking tongue may be associated with severe dyspeptic symptoms, or even with serious organic disease of the alimentary canal or its related organs. Many persons have the surface of the tongue much furrowed.

1. **Nervous diseases.**—In this class of diseases the tongue often affords information of much value, and it is here that its sensations and movements are mainly disordered. In many cases of cerebral lesion one half of the tongue is paralysed in its muscles, so that the organ is unsymmetrical in the shape of its two sides; and deviates, when in the mouth to the healthy side, but when protruded towards the paralysed side. In exceptional cases the entire organ is affected, so that it cannot be protruded or even moved. The way in which a patient attempts to put out the tongue when asked to do so, may be made use of to indicate the state of consciousness in various conditions affecting the brain. In many cases of cerebral disease the tongue shows a marked and speedy tendency to become thickly furred, and very foul. This is well seen in cases of apoplexy due to hæmorrhage.

The tongue is specially affected in certain peculiar nervous diseases, especially labio-glosso-laryngeal paralysis, many cases of diphtheritic paralysis, general paralysis of the insane, and extreme cases of wasting palsy. Beginning with slight indications of loss of power, as tremulousness, thickness of speech, and difficulty in swallowing, the affection is liable to end in complete

paralysis of the organ, which may also involve its sensibility. These results depend on disease involving the roots of the nerves supplying the tongue. The organ may also be thus affected in various degrees, owing to some morbid condition implicating its nerves in their course or at their origin. When completely paralysed, the tongue in time may come to present the appearance of a sodden mass lying in the mouth. In cases of severe neuralgia of one side of the face, the tongue occasionally presents peculiar appearances, such as unilateral furring, thickening of the mucous membrane, or enlargement of the papillæ. The tremulous and foul tongue of acute or chronic alcoholism may also be mentioned under this head. Signs of the organ having been bitten may be useful in the diagnosis of obscure cases of epilepsy. The jerking and irregular movements of the tongue are very striking in many cases of chorea. During attacks of migraine its surface usually becomes much furred.

2. **General conditions and diseases.**—The tongue is usually markedly altered in the febrile state, whether associated with specific fevers, or with inflammatory diseases. It becomes covered with more or less fur, often of considerable thickness, and usually either white or yellowish-white. In particular fevers the organ commonly presents peculiar characters. Thus, in most cases of typhoid fever it is small and irritable, with enlarged papillæ, and a thin, whitish or yellowish fur; or sometimes it is red, smooth, and glazed or shining. In this disease it may be peculiarly tremulous, and this has been regarded as a bad sign, as indicating deep ulceration of the intestine. In scarlatina the papillæ tend to become much enlarged and prominent, so that they project through the fur, and the tongue in many cases presents the so-called 'strawberry' appearance. In diphtheria it may exhibit a diphtheritic deposit upon its surface. There is generally a very thick, creamy fur in acute rheumatism, as well as preceding and during attacks of gout, and in the latter especially it often becomes brownish. In acute pneumonia also the tongue is usually thickly coated. In the 'typhoid state,' whatever this condition may be associated with, the tongue is dry, and usually covered with a brown or even blackish crust, appearing as if it were baked. It is often very red and irritable in itself, and occasionally the typhoid tongue has little or nothing on its surface, but is very dry, deeply red, like raw beef, and fissured. This is due to the fact that the long-continued pyrexia, especially if high, prevents the formation of epithelium. The organ may be in such a condition that it can scarcely be moved at all. At the same time sordes are present on the teeth and gums. In malarial fevers the margins of the tongue are said to present sometimes a faint bluish tinge.

It may be remarked here that the tongue not uncommonly affords evidence of constitutional syphilis, owing to the past effects of this disease upon the organ. It also indicates the general tone of the system, being usually large and flabby when this is below par. In some instances of diseases attended with marked general wasting, the tongue comes to present an irritable appearance.

3. **Conditions affecting the blood and circulation.** — The tongue often exhibits abnormal characters, due to the state of the blood or circulation. Thus, in anæmia it is more or less pale; generally large, flat, broad, and flabby; and frequently marked at the sides by the teeth. In the plethoric condition it is also large, but tends to be of a deeper colour than normal, and may present a venous tint. The anæmic tongue is frequently quite clean, though this will depend much on its cause; but the tongue of plethora is generally furred, on account of the condition of the alimentary canal. A temporarily congested condition of the digestive organs and liver is supposed to produce a corresponding plethoric state of the tongue. Any cause of general obstruction to the venous circulation, or of interference with the due aëration of the blood, whether seated in the heart or lungs, is likely to give rise to enlargement of the tongue, and to make it assume a congested, or even a cyanotic appearance in marked cases, such as those of congenital malformation of the heart. It occasionally happens that some local obstruction, affecting the large veins in the thorax, as from the pressure of an aneurism, produces a similar condition of the tongue.

4. **Affections of the alimentary canal and its related organs.**—The tongue is of peculiar importance in relation to these organs, in most cases affording very definite and valuable information as to their condition. Indeed, some of the deviations from the normal state already considered depend directly upon disorder affecting the digestive apparatus. Without attempting to give a complete or detailed account of the varieties of abnormal tongue associated with diseases of these parts, the general indications which it affords may be thus pointed out.

*a.* The tongue is peculiarly liable to be altered in local affections of the mouth and throat. In catarrh of these parts it is more or less furred. In tonsillitis there is usually a very thick fur; and it may be most marked on the side of the inflamed tonsil. Even a local irritation, such as that caused by decayed teeth, may originate a fur, and it is under such circumstances that it is liable to be localized.

*b.* In any acute disorder of the alimentary canal the tongue speedily becomes furred, usually either white or yellowish-white, but it may be more or less brown. This is seen in so-called acute dyspepsia, catarrh of the alimentary canal, and hepatic disorders. The fur often disappears very speedily. In severe acute gastritis the organ often presents a strikingly red and irritable appearance, especially at the tip and edges, with enlarged papillæ, and a tendency to dryness.

*c.* In chronic forms of dyspepsia and gastric catarrh, the tongue presents different appearances according to circumstances. In the atonic variety it is usually large, flat, soft, and flabby; frequently marked with the teeth; and more or less furred, though it may be quite clean. In the irritative form it tends to be small, elongated, and pointed; contracted and firm; red and irritable; with enlarged papillæ; and generally only having a thin white fur, through which these papillæ project, but it may appear unusually

clean and raw-looking. The organ may present characters more or less similar to those just described, in those cases where the food passes rapidly out of the stomach into the duodenum in an undigested state. In the more grave diseases of the stomach, namely, cancer and ulceration, the tongue has no special characters, and indeed is often very healthy-looking; its characters will depend on the state of the gastric mucous membrane generally.

*d.* The relation of the tongue to affections of the intestines is not so evident as in the case of the stomach. When they are implicated together in the same disorder, the organ presents the characters already indicated. The bowels, however, are often much deranged or diseased without any abnormal appearances being exhibited by the tongue, provided the stomach is unaffected. It may be said, however, that constipation, especially if habitual, tends to make the tongue large and furred, particularly if associated with portal congestion and deficiency of bile. In some cases of chronic intestinal catarrh, with diarrhœa, the organ presents an irritable appearance. In chronic dysentery it often becomes red, glazed, or fissured.

*e.* As regards the organs connected with the alimentary canal, it is only the liver which can be stated definitely to affect the tongue. As has been already mentioned, any interference with the portal circulation is liable to cause a plethoric condition of the organ; and, owing to the effects produced on the alimentary canal, it becomes more or less furred. Any deficiency of bile in the intestines also leads to furring of the organ; and if this is very marked, or if the bile is entirely absent, the tongue tends to become very foul. It is much affected in acute biliary disorders; and may become coloured yellow in jaundice.

5. **Special diseases.** — In diabetes the tongue is often peculiarly irritable, red, clean, cracked, and dry. In acute peritonitis it is usually remarkably small and contracted, also red and irritable, with but little fur, and tending to dryness. In advanced cases of phthisis, especially with a high temperature, it frequently becomes red and raw, and exhibits enlarged papillæ; the occurrence of thrush upon its surface may also be a sign of approaching dissolution in this disease. These illustrations will suffice to point out the special information which the tongue may afford as regards particular diseases.

Conclusion.—By a consideration of the characters of the tongue, it will be seen from the foregoing remarks that important and valuable indications are often afforded, not only as regards diagnosis, but also for prognosis and treatment. Therefore it is essential that its characters should be properly studied in every case, bearing in mind the three clinical aspects which it presents to the practitioner, namely, its sensibility, movements, and objective characters.

Frederick T. Roberts.

**TONGUE, Diseases of.**—Synon.: Fr. *Maladies de la Langue*; Ger. *Krankheiten der Zunge.*

The principal morbid conditions affecting the tongue may be thus enumerated in alphabetical order:—1. Adhesions; 2. Atrophy; 3. Cancer; 4. Hypertrophy; 5. Inflammation; 6. Parasitic affections; 7. Syphilis; 8. Tongue-tie; 9. Tumours; 10. Tylosis; and 11. Ulceration. Aphthæ and thrush are discussed under their respective headings (*see* Aphthæ; and Thrush). The simpler disturbances of the surface of the tongue, of which the practitioner avails himself as an aid to diagnosis, are separately discussed. *See* Tongue.

1. **Adhesions.**—Occasionally the tongue is attached more or less extensively at its sides and under surface to the corresponding surfaces of the mouth. These adhesions may be congenital, but more frequently they are the result of ulceration or sloughing.

Treatment.—In congenital cases the membranous bands may either be divided with blunt-pointed scissors or with a scalpel; or, if they are too thick and extensive to be treated in this way, a ligature may be passed round them, and drawn tight, so as to bring about their division. Adhesions which have been caused by ulceration or sloughing may be dealt with in a similar manner, but the result is much less hopeful.

2. **Atrophy.**—Some degree of atrophy of the muscular substance of the tongue usually accompanies those forms of paralysis which affect its nerves. If the paralysis be considerable, the muscular fibres become wasted, but the bulk of the organ is often kept up by the interstitial deposit of fat. Besides this, there are two groups of cases in which there is well-marked wasting. These are (*a*) cases in which there is disease of the medulla oblongata, involving the hypoglossal nucleus; and (*b*) cases in which the ninth nerve is diseased or injured between the cerebrum and the muscles to which it is distributed. The cases which fall under the first head may depend upon softening, hæmorrhage, syphilitic disease, or other causes. This class includes the labio-glosso-laryngeal paralysis of Duchenne. Those which come under the second head are due to morbid growths of different kinds, or to accidents or injuries. The atrophy may affect both sides equally, or only one. *See* Hypoglossal Nerve, Diseases of.

Treatment.—Treatment must be directed to the cause of the complaint.

3. **Cancer.**—Ætiology.—Cancer of the tongue is most frequently seen between the ages of forty and seventy; and it is more than twice as common in men as in women.

Description.—Cancer of the tongue commences either as a small excrescence, blister, or crack; or as a hard lump in the substance of the organ. Its origin may often be traced to some local irritation, or to some previous lesion. In whatever way it begins, the same symptoms are common to all varieties. There is occasional darting pain, radiating towards the ear, temple, and vertex. The diseased portion is tender; eating is rendered difficult; speech is thick and indistinct; the base of the tongue becomes infiltrated; and the organ cannot be freely moved or protruded from the mouth. The sublingual and submaxillary glands, as well as those which are connected with the lymphatic system, become enlarged and painful. There is an increased flow of saliva. The circu-

lation through the brain may be disturbed, and the patient then complains of giddiness and headache. Rapid wasting and loss of strength manifest themselves.

The local disease gradually involves more and more of the mouth. Sometimes large sloughs form, and profuse bleeding takes place. The difficulty of swallowing and even of breathing is great, on account of the obstruction which the disease causes at the pharynx; and this obstruction is increased by œdema, the result of retardation of the venous current. Gradually the growth invades the neighbouring parts; and frequently, before death takes place, bronchitis or pneumonia sets in. The most common seat of cancer of the tongue is on the side of the organ, at its middle or back part. It is almost always of the epithelial variety; very rarely it is scirrhous or encephaloid. Its average duration is fifty-seven weeks; but if the cases which are submitted to operation are taken by themselves, its average duration is eighty-six weeks.

Diagnosis.—The earlier stages of cancer of the tongue are sometimes difficult to distinguish from the simple affections of that organ, and still more frequently are they confounded with its syphilitic diseases. Indeed, the diagnosis between cancer and syphilis is a matter which often requires very nice discrimination.

Treatment.—Nothing effective can be done by medicines to induce the cure of a cancer, or to arrest its growth. It is hardly necessary to say that everything should be done to rectify the patient's general health, and that all sources of local irritation should be removed. But our main reliance must be placed in operative treatment. Operations are either complete, when the whole disease can be removed; or palliative, when they are undertaken merely for the relief of symptoms. They may be performed either with the knife, scissors, the galvano-cautery, the écraseur, or the ligature. Which of these means is used must depend upon the circumstances of the case. The knife is the most expeditious, but then there is sharp bleeding, and for this reason the patient cannot take an anæsthetic. But when the écraseur or the galvano-cautery is used, there is little or no hæmorrhage, and anæsthetics can be given. The ligature is seldom used, because it involves the presence in the mouth for some days of a disagreeable slough. When the case admits only of palliative treatment, portions of the diseased tissues may be removed; or the gustatory nerve may be divided to relieve pain and excessive salivation; or the lingual arteries may be tied to arrest hæmorrhage. Supposing, however, that the case admits of no operation, pain may be blunted by conium, and sleep procured by opium and its allies; whilst in some instances the subcutaneous injection of morphia is of the utmost value. Sometimes the backward pressure is so great that the patient is unable to swallow, and then it may be necessary to feed him by means of the stomach-pump or by enemata.

4. **Hypertrophy.**— Synon.: *Macroglossia; Prolapsus linguæ.*—Hypertrophy consists in an over-development of the tongue, and is usually associated with prolapse. Generally it is congenital; sometimes it follows an attack of inflammation. In the congenital cases it is often complicated with imperfections in other organs, or with idiocy. At first the enlarged tongue has a normal appearance. Gradually, from exposure to the air and constant stimulation, the mucous membrane becomes dry, thickened, and callous, or covered with a slimy secretion; while the papillæ become larger and more prominent than natural. After a time the pressure of the teeth acts as a line of constriction, and the protruding portion of the organ rapidly enlarges from mechanical congestion. The surface of the tongue becomes bluish or brown; the mucosa roughened and cracked; there is a tendency to ulceration and hæmorrhage; the muscles become palsied, and are unable to retract the organ. As time goes on, the lower jaw is pressed down by the superincumbent weight, and occasionally this goes so far as to produce dislocation. The teeth project forwards, the lips are everted, and there is a constant flow of saliva from the mouth. Altogether, the patient's appearance is most unsightly, and his condition very distressing; for with such a tongue mastication and deglutition are difficult, and speech is thick and indistinct.

Treatment.—Bandaging, with astringent lotions, and strapping, should first be tried. If this fails, an operation for the removal of the redundant part must be undertaken.

5. **Inflammation.**—Synon.: Glossitis.—Occasionally the surface of the tongue is covered by a crop of vesicles—a kind of herpetic eruption—and this without affecting the deeper structures. At other times the whole substance of the organ becomes acutely inflamed.

Ætiology.—Fifty years ago by far the most common cause of inflammation of the tongue was the excessive use of mercury; but happily mercurial glossitis is now seldom seen. In some cases acute glossitis arises from a chill; the inflammation, for some reason which it is not easy to explain, attacking the tongue, just as in other cases the same exciting cause gives rise to coryza or quinsy. Sometimes it is due to the contact of septic substances, or to the eating of particular articles of food, or to taking corrosive or acrid substances into the mouth; or it may arise in the course of fevers or eruptive diseases, or sometimes without any assignable cause.

Symptoms.—The earliest symptom of glossitis is a red line along the gums, at their junction with the teeth. The gums are tender, spongy, and apt to bleed. At the same time the breath acquires a peculiar and offensive fœtor, known as mercurial, and the patient has a disagreeable metallic taste in his mouth. As the case advances, the gums, the tongue, and the inside of the lips and cheeks become much swollen. The tongue is sometimes so large as to protrude constantly from the mouth. At its edges it becomes deeply marked by the teeth, and it is very prone to ulceration. The flow of saliva is incessant. The salivary glands are enlarged and painful; and the teeth ache and become loose, though it seldom happens that they drop out. The pulse and respiration are hurried. There is great thirst, but the patient has difficulty in swallowing; and he is wholly unable to speak. As a rule this state of things subsides under proper treatment but occasionally matter forms

in the substance of the tongue, or it may become ulcerated or even gangrenous.

Treatment.—In acute inflammation of the substance of the tongue, scarification—in the form either of one or two long incisions, or of a number of punctures with the point of a lancet—or the application of leeches beneath the jaw may be needed, if the symptoms are urgent, and the patient plethoric. But generally milder measures will suffice, for instance, a saline purgative, or a drop or two of croton oil, followed, if need be, by enemata from day to day, together with a mustard plaster to the throat, and a suitable mouth-wash. As a wash, while the inflammation is at its height, there is nothing better than warm water or poppy decoction. Subsequently dry powdered alum may be dusted on the tongue; or a lotion of alum, chlorate of potash, or borax may be employed. As a change, a wash containing dilute nitric, hydrochloric, or acetic acid may be prescribed; but these must not be continued too long. At the same time ammonia, iron, quinine, or bark should be given. If an abscess form far back in the tongue, and if it can be localised with sufficient accuracy, an incision should be made with a view to its evacuation. If pus is set free, the patient will experience immediate relief, and the disease will soon be cured.

6. **Parasitic Affections.**—The most important parasite connected with the tongue is the *Oïdium albicans*, which is present in thrush (*see* Aphthæ; and Thrush), with which the minute beaded strings of *Leptothrix buccalis* are often associated. *Hydatid cysts* are occasionally met with; and so is the *Cysticercus cellulosæ*. Among the næmatodes the *Guinea worm* (*Dracunculus* or *Filaria medinensis*) and the *Trichina spiralis* have been found. The dracunculus may give rise to an abscess, which will require to be opened; and hydatid cysts will have to be excised.

7. **Syphilitic Affections.**—These form five-ninths of all the lesions of the tongue which come under our notice. Primary sores are occasionally seen in this situation, but their occurrence is so rare that we need only mention them. For the sake of clearness it is well to arrange these syphilitic affections into four classes:—(*A*) *superficial ulcerations*; (*B*) *mucous tubercles and vegetations*; (*C*) *gummy tumours and deep ulcerations*; and (*D*) *chronic morbid states* of the mucous membrane.

*A. Superficial Ulcerations.*—Slight superficial ulcerations of the tongue are very common in what is called the secondary stage of syphilis. They are usually situated on the sides, tip, and under surface of the free portion of the organ; and are often associated with similar ulcerations upon the inside of the cheeks, the lips, and the angles of the mouth. They begin in small inflamed spots, and spread into linear cracks and fissures (rhagades). These are exquisitely sensitive, and, as it is very difficult to keep the tongue at rest, are a source of constant suffering. When these ulcerations heal, whitish scars and cicatrices are left, which are very persistent. When these scars are extensive, so as to form patches, their appearance somewhat resembles tylosis, though they are essentially different from that disease.

*B. Mucous Tubercles and Vegetations.*—Mucous tubercles, when they occur on the tongue, are generally met with about the sides and under surface of the organ, or on the fold of mucosa that is reflected to the floor of the mouth; and they have been noticed to coexist with mucous tubercles about the anus, the labia, and other parts.

*C. Gummy Tumours and Deep Ulcerations.*—Gummata are common in the tongue. Sometimes, when they first come under notice, they are not larger than a pea; at other times they are as large as a marble. Histologically they consist of granulation-tissue, which becomes very imperfectly organized into a fibrous structure, and rapidly undergoes degenerative changes, so that the growth comes to be made up of atrophied and broken-down cell-products, imbedded in an incompletely fibrillated matrix. When they degenerate they form a soft, semi-fluid material, which may either be absorbed, or make its way slowly towards the surface. When they take the latter course, they break, discharge, and, under appropriate treatment, ultimately heal up. Sometimes, however, they form the starting point for deep and intractable ulceration.

*D. Chronic Syphilitic Disease.*—Various morbid conditions of the mucosa of the tongue are often seen in association with the later stages of syphilis. Sometimes circumscribed patches of the epithelium become dead-white, and drop off, leaving a red, raw surface beneath. The epithelium is speedily restored, but another patch becomes affected in a similar manner, and so the disease continues—one patch healing and another desquamating. This is the proper *psoriasis linguæ*. Again, there is a much more extensive disease, to which the name *chronic superficial glossitis* has been given. At the commencement some portions of the membrane present their natural appearance, while others are of a deep red colour and raw-looking. These patches are often oval or oblong. Their surface is smooth and glossy. They are either entirely denuded of epithelium, or this is reduced to an extremely thin layer, and the papillæ are obliterated by distension. These patches are slightly elevated and hard to the touch, in consequence of interstitial thickening. The tongue is swollen. At its edges it takes the impression of the teeth, and the lines thus produced are prone to ulcerate. Sometimes the whole organ has a bluish, congested hue, as if its circulation were retarded in consequence of the matted and thickened state of the tissues. The mucous secretion all over the affected part is viscid and glairy, giving the organ a peculiar, smooth, glazed appearance; and sometimes the patient's breath is so fœtid that he is offensive to himself and to all about him. He complains of thirst; his mouth is parched, especially at night; and when he wakes in the morning, his tongue feels dry and chipped. The disease is, in fact, a chronic glossitis, limited to the mucous membrane. Supposing the more active mischief to be checked, the swelling subsides, and the tongue resumes its normal size—indeed it may become smaller than natural, and rather misshapen from the irregular contraction of the diseased parts.

But the membrane never resumes its healthy character. The patches that have been affected remain smooth and shining. The papillary structure has been impaired, and what is left is in fact cicatricial tissue, a tissue which is exquisitely sensitive to the contact of hot, acid, or pungent substances, and which is apt to become inflamed from very slight causes. At a later date portions of this cicatricial membrane become more completely fibrous, presenting a whitish appearance, and being callous to the touch.

This condition is most frequently seen in persons who have long been affected with syphilis; and the question will sometimes arise whether it is due to the disease, or to the prolonged use of the drugs by which this has been combated. Syphilis is so prone to manifest itself in the tongue, that no doubt in some cases the appearances described are entirely produced by it—possibly by syphilis in association with dyspepsia. But in other cases, particularly in those which are attended by fœtor and an alteration in the mucous secretion, it seems certain that they have been aggravated, if not caused, by excessive medication. In some instances this excessive medication may be the result of iodide of potassium, in others of mercury; for both these drugs, as is well known, but especially the latter, are apt to determine to the mucous membrane of the mouth. But in other cases the chronic superficial glossitis seems to be due to severe and prolonged dyspepsia, or perhaps to other non-specific causes, such as gout, which impoverish the blood, irritate the stomach, and impair the nutrition of the mucosa of the tongue.

Treatment.—In the treatment of these syphilitic affections, it is of importance that the tongue should have rest, and the practitioner should satisfy himself that the patient is living tolerably well, and is warmly clad. Unless he has a certain amount of *vis vitæ*, it is impossible for him to overcome the intensity of the syphilitic poison.

If the so-called specific drugs have already been given to excess, we must confine ourselves to local treatment, and to the administration of stomachics and tonics. But if the patient have not already been overdosed with mercury or iodide of potassium, we naturally turn to them as our most powerful remedies. In the case of the superficial ulcerations about the sides and tip of the tongue, the best plan is to touch the fissures with a fine pencil of nitrate of silver, and to prescribe iodide of potassium, or perhaps a mild course of grey powder. In the case of gummy tumours, if they are seen early, their absorption may be promoted by iodide of potassium or the perchloride of mercury, or by a course of mercurial inunction or fumigation. If they have softened and broken, they should be allowed to discharge, like an abscess; care being taken to keep up the patient's general health, so that they may heal kindly. If they show any tendency to ulcerate, they should be freely touched with nitrate of silver. The deeper and more obstinate ulcerations may require the application of nitric acid, or of the acid nitrate of mercury; and along with such treatment a mild course of mercury should be combined.

Mucous tubercles on the tongue generally yield speedily to the local application of nitrate of silver; and a course of iodide of potassium, grey powder, or iodide of mercury.

The treatment of chronic superficial glossitis is far from satisfactory. The first object should be to improve the digestion, and to regulate the general health. With this view the vegetable bitters and the mineral acids should be given; or bismuth and hydrocyanic acid; or effervescing mixtures containing an excess of alkali. These and other remedies will suggest themselves according to the particular variety of gastric irritation from which the patient is suffering. If there be reason to think that the disease is of syphilitic origin, and that specific drugs have not already been given to excess, iodide of potassium or mercury may be prescribed in moderate doses, either separately or in combination. With either of these lines of treatment it is well to order opium, especially Dover's powder, hyoscyamus, conium, chloral, or bromide of potassium, in sufficient doses to quiet the system and procure sound sleep.

When there is much superficial soreness, a mouth-wash of borax and glycerine, bismuth and glycerine, or chlorate of potash, should be ordered.

8. **Tongue-tie.**—The tongue is said to be 'tied' when the frænum is either too short or comes further forward than it should, and thus restrains the movements of the anterior part of the organ. The infant cannot put out its tongue, or use it in sucking; and if the defect is allowed to remain, it interferes with speech.

Treatment.—The remedy is to snip the frænum with a blunt-pointed pair of scissors, the points being directed downwards so as to avoid the ranine arteries and veins. Mothers often suppose that their children are tongue-tied when, in truth, they are only backward; so the surgeon should be on his guard, and not operate unless he sees good cause.

9. **Tumours.**—The tongue may be affected by tumours which are neither parasitic, cancerous, nor syphilitic. Thus, the mucous membrane is occasionally the seat of a nævus, of simple warts, or of polypi. Cysts are also met with, not merely beneath the tongue, but also in its substance; and fatty, fibrous, and fibrocellular growths have from time to time been removed from this situation.

Treatment.—Warts should be touched with lunar caustic or with nitric acid, or even excised, Polypi should be ligatured, or snipped off with scissors. The other tumours mentioned will all require operation.

10. **Tylosis.**—Synon.: *Ichthyosis linguæ.*—This is a peculiar disease, which affects the tongue, and, to a slight extent, the adjacent mucous membrane.

Ætiology.—The irritation which gives rise to tylosis may be due to excessive smoking or drinking, superficial syphilitic ulceration, or to other causes, such as gout. It is almost entirely confined to men, and is never seen before the age of puberty.

Description.—Tylosis consists in an overgrowth of the papillary and epithelial elements of the mucosa, which become white and sodden from continued immersion in the fluids of the mouth. It is the filiform papillæ which are

chiefly affected, and the disease never spreads further back than the line of the circumvallate papillæ. Sometimes the papillæ, though enormously enlarged, and overloaded with epithelium, retain their separate form; at other times they are welded together into smooth, hard, masses. The tylotic coating presents a silvery or snow-white appearance, quite different from any ordinary fur. When the disease has once shown itself, it is very persistent. Its essential nature appears to be that of a chronic inflammation. Sometimes the patches are irregular in form and in situation; at other times they have a remarkably symmetrical arrangement. The disease appears to have a strong tendency to become cancerous, though it may last for twenty or thirty years before it passes into that stage.

Treatment.—If the patch be small, it should be excised; and when the disease has reached the epitheliomatous stage, it must be dealt with as a cancer. But between the early and the late stage the less it is meddled with the better. If any local treatment be used, it should be of a mild and soothing kind. The use of strong caustics, as well as all parings and scrapings, should be forbidden. Mercury, arsenic, or iodide of potassium may be tried, but little dependence can be placed on them. They may produce some amendment, but they cannot effect a cure. Our best hope is to guard the tongue against all sources of irritation, and to regulate and improve the general health.

11. **Ulceration.**—Ulcers of the tongue, as already said, may be syphilitic or cancerous, but they may also be of simple origin. Simple ulceration is usually associated with dyspepsia. Dyspeptic ulcers are apt to occur in ill-fed children, and also in adults who habitually eat and drink freely. Such ulcers are generally situated upon the sides or upper surface near the tip; but not unfrequently they are on the frænum. They are encircled by an inflamed margin; shallow; their bases being flat and covered with a greyish slough. They are very sensitive to the touch, and painful when the organ is moved. Sometimes there is offensive discharge, with a good deal of swelling of the sublingual and submaxillary glands.

Simple ulceration is often excited by external causes, acting upon the tongue at a time when its nutrition is impaired by faulty digestion. Thus it may be bitten, or scalded, or wounded with knives or forks, or irritated by the sharp point of a tooth, or by a rough accumulation of tartar.

Treatment.—Attention should at once be directed to the digestive organs; and, after a cholagogue purgative has been given, a course of alterative medicine should be ordered, to be followed by stomachics and tonics. Arsenic sometimes acts like a charm. Whatever dyspeptic symptoms are present must be met by their appropriate remedies, for example, dilute hydrocyanic acid, bismuth, chlorate of potash, or bromide of potassium. As a local application, there is nothing better than nitrate of silver. In the case of ulceration following injury, the sore should be touched with caustic, and the patient's general health regulated and supported.

W. Fairlie Clarke.

**TONIC** (*τόνος*, tension).—A distinctive term used in reference to the nature of spasms, which are usually divided into two classes, namely, *tonic spasms* and *clonic spasms*; the former being those in which the muscles concerned remain in a state of continuous rather than in one of intermittent contraction. *See* Spasm.

**TONICS** (*τόνος*, tension, tone).—Synon.: Fr. *Toniques*; Ger. *Tonische Mittel*.

Definition.—Therapeutic agents which impart permanent strength to the body or its parts.

Enumeration.—Amongst the most typical medicinal tonics, which impart a feeling of strength, are iron, nux vomica, quinine, and vegetable bitters. As the strength of the body generally depends on the proper action of its various parts, tonics have been subdivided into those which have an especial action on the blood circulation, digestion, and nervous system.

1. **Blood Tonics.**—Cod-liver oil and other fats, and iron and its salts, are the most important of this group of tonic remedies. Perhaps also phosphate of lime, and salts of potash and soda should be included. Light, fresh air, good food, bathing, and exercise are valuable adjuncts.

2. **Vascular Tonics.**—The principal vascular tonics are nux vomica and strychnia, digitalis, hellebore, erythrophleum, and squill. The local application of warmth and cold, friction, and massage increase the effect of these medicines.

3. **Gastric Tonics.**—Small doses of sulphuric, nitric, and hydrochloric acids, small doses of arsenic, small doses of alum, aloes, small doses of bismuth, bitter beer, chamomile, cinchona, casparia, cascarilla, small doses of copper, calumba, hops, gentian, orange and lemon peel, quassia, rhubarb, small doses of silver, strychnia, generally vegetable bitters, and small doses of zinc—all impart vigour to the gastric function. Valuable adjuncts are pepsin and hydrochloric acid.

4. **Intestinal Tonics.**—These are chiefly nux vomica, belladonna, rhubarb, the mineral acids and metallic salts just mentioned, and astringents.

5. **Nervine Tonics.**—Nux vomica and strychnia, cinchona and its alkaloids, coca, phosphorus, arsenic and its compounds, salts of iron, zinc, copper, and silver, are all included under this head. The tonics which act especially on other parts of the system increase also the power of the nervous system, and act indirectly as nervous tonics.

Action.—The derivation of the word 'tonics' indicates the nature of their action. When a person feels limp and weak, and unfit for exertion, like a relaxed bow-string, tonics restore the energy and strength, and render him again fit for work, like, as it were, a re-tightened bow. The exact mode in which tonics act is not yet perfectly ascertained, but in all probability they increase the functions of the different parts of the body by aiding tissue-change, either by increased nutrition, increased tissue-metabolism, more rapid removal of waste, or possibly by all three taken together.

Uses.—Tonics are employed in conditions of debility, either of the body generally or of its

different parts, the selection of each depending upon the part of the body affected.

In cases where the malnutrition of the body appears to be dependent on the want of the proper constituents of the blood, as in anæmia, struma, or general debility, without any affection of a particular organ, *blood tonics*, including iron, cod-liver oil, and phosphates are employed; and these are also useful where impoverishment of the blood is due to a definite constitutional disease, such as phthisis, or Bright's disease. Where enfeeblement of the stomach appears to be present, as shown by loss of appetite and such signs of imperfect digestion as flatulence, weight, and pain after eating, *gastric tonics* are used. Should its muscular coat be feeble or inactive, as shown by tendency to dilatation, and splashing of the contents on movement, strychnia is especially indicated, and galvanism or systematic kneading may be also employed. Where the stomach is too debilitated to respond sufficiently to this form of treatment, as after long-continued gastric catarrh, or in old age, its work must be partly done for it, and then such substances as hydrochloric acid and pepsin are useful. When the muscular movements of the intestine are sluggish, as indicated by constipation, and by a tendency to the distension of the bowel with gas, nux vomica and belladonna may be given; and when its mucous membrane appears to be relaxed and flabby, and secreting too profusely, the mineral acids, astringents, and metallic salts may be of much service. When the pulse is soft and feeble, and there is a tendency to vascular dilatation, either general or local, as shown by local congestion and œdema of dependent parts, or by drowsiness in the upright position and sleeplessness in the recumbent posture, *vascular tonics* are serviceable. *Nervine tonics* are used where the nervous functions are imperfectly performed, as shown by dulness, loss of memory, incapacity for work, languor, or tendency to spasm, as in chorea, and also in paralysis. As the functions of this system depend very greatly upon the quality of the blood with which the nervous system is supplied, and on the rapidity of the circulation, the other tonics frequently require to be given in addition to nervous tonics.

In administering tonics, care should always be taken to ascertain that the case is suitable, for in very many cases of apparent debility the imperfect functional activity of the body or of its parts does not depend upon insufficient nutrition, but upon imperfect removal of the products of waste. The proper treatment in these cases is not to give tonics, but to remove the waste products by cholagogues, purgatives, and diuretics.

T. Lauder Brunton.

**TONSILS, Diseases of.**— Synon.: Fr. *Maladies des Amygdales*; Ger. *Krankheiten der Mandeln.*

These two glands, situated between the anterior and posterior pillars of the fauces, are unusually liable to participate in all affections of the throat, both from their peculiar structure and from their position. An evident example of the truth of this statement is to be found in that



every-day affection, a common cold, in which the tonsils usually exhibit symptoms of the general catarrh. They are also involved in diphtheria, scarlatina, and syphilis; they may be the seat of ulcers, or even gangrene; and they may be involved in malignant disease. The following affections demand special notice, namely, (1) **acute inflammation**; (2) **follicular catarrh**; (3) **hypertrophy**; and (4) **tonsillar calculus.**

1. **Acute Inflammation.**—Synon.: Tonsillitis; *Cynanche Tonsillaris*; *Amygdalitis*; Quinsy.

Ætiology.—This affection is most commonly met with in young persons, in the damp weather of spring and autumn, and one attack seems to predispose to another. Exposure to damp, cold, and wet is generally regarded as sufficient to excite this disorder.

Symptoms.—These usually set in with indications of fever. The patient becomes restless, irritable, and hot (the temperature in very acute cases rising to 104° or 105°); complains of headache and general weariness; and may be delirious at night, especially if young. The tongue is covered with a thick, heavy, yellowish coating; the other symptoms of oral catarrh are present; the breath is unpleasant; and salivation is complained of. The patient loses the power of opening the mouth to any extent; and swallowing is attended with much pain and great difficulty, the food not unfrequently returning through the nose. The tone of the voice is altered, becoming thick, guttural, and nasal. The breathing is not, as a rule, impeded, but the patient snores during sleep; and when he is awake, respiration may be noisy. Occasionally he becomes deaf. The first indication of uneasiness in the throat is a complaint of pricking and dryness in the region of the tonsil, soon passing on to actual soreness, and pain of a dull character, which shoots up towards the ear on the affected side. Externally, behind the angle of the lower jaw, considerable swelling is observed, firm, and exceedingly painful to touch. On examination of the parts internally, one tonsil, rarely both, will be found to be greatly swollen, of a bright red colour, perhaps with patches of yellowish secretion adherent to its surface. The soft palate is also greatly swollen, red, œdematous, and falling inwards to the middle of the mouth. The uvula likewise partakes of the general infiltration, and is usually found pushed to the healthy side, and not unfrequently adherent to the tonsil. This state of matters continues for four or five days, increasing in severity, and then it may gradually begin to subside, the inflammation passing off; and in ten days to a fortnight the patient is able to resume his usual employment. Quite as frequent a termination as resolution is suppuration and formation of abscess in the tonsil. In such a case the symptoms are generally aggravated before the formation of the pus, and more decided pain and throbbing are complained of, extending upwards to the ear. The abscess may burst spontaneously and unexpectedly. After the evacuation of the pus, which is often fetid, convalescence is speedy.

Treatment.—If a case of quinsy is seen at the very outset, an attempt may be made to abort the disease. This, though seldom successful, may be tried by giving an emetic, or by administering tincture of aconite every hour in drop doses;

or alum or nitrate of silver may be applied to the inflamed throat. If not seen for two days, or if these abortive measures fail, the patient should be confined to bed; hot poultices kept constantly round the throat; steam inhaled as often as practicable; and gargles of warm milk and water made use of every hour. A brisk saline purgative should be given. Ice, if found grateful, may be allowed at discretion. Such diet as the patient can be persuaded to swallow should be ordered, of course in liquid or rather semi-solid form. Stimulants, if called for, must be administered. Tonics, such as chlorate of potash and iron, or quinine and iron, will be needed when convalescence sets in. If an abscess should form, it must be evacuated by means of a well-protected bistoury; and astringent gargles should be made use of for some time after convalescence is established.

2. **Follicular Catarrh.**—The office of the tonsils is to secrete a lubricating fluid to the bolus of food as it passes into the pharynx, as well as to moisten the fauces. Occasionally we meet with cases where this secretion is altered in character or in quantity. And this may be the result either of a simple catarrh of the tonsils; or of thickening of the interstitial tissue of the gland, compressing the follicles, and thus interfering with the free outflow of the secretion. The appearance of the tonsil in such a condition is at times mistaken for a diphtheritic state, in consequence of the whitish patches of secretion deposited upon them. In this catarrhal affection it will be observed that there is no tendency to the formation of a true membrane as in diphtheria, the deposit assuming a pultaceous form, being readily removed, its borders being well-defined, and it is seen to proceed from the follicles of the tonsil. As to the treatment of this condition, all that is wanted is a stimulant gargle, probably some general tonic, and the constant use of chlorate of potash—a convenient form of administering which is found in Wyeth's lozenges of the compressed salt.

3. **Hypertrophy**—This condition of the tonsils is met with both in the young and in the adult. In the case of the former, there seems to be a hereditary tendency in some families, the tonsils becoming immensely large even as early as the second year. In such there is usually some scrofulous habit of body. In the adult this condition is more frequently the result of repeated angina, which induces a permanent thickening of the structures of the tonsils, whereby the secretion, no longer finding free exit, distends the follicles, thus setting up a low form of inflammation, which results in hypertrophy of the gland. This condition is free from pain. When the interstitial tissue becomes much thickened and indurated, there occurs what is sometimes described as 'scirrhus' of the tonsil. The symptoms indicative of hypertrophy are snoring during sleep; obstruction to the breathing, in consequence of which the mouth is always open night and day; slight impediment to swallowing, with a sense of something permanently needing to be swallowed; some degree of deafness; and thickness of voice or snuffling. These are all greatly aggravated when catarrh is superadded; and persons having enlarged tonsils are specially liable to attacks of angina, and to severe throat-symptoms when any disorder overtakes them, in which the throat is more than ordinarily the point in which the disease centres itself, for example, scarlatina.

Treatment.—The treatment in cases of scrofulous children consists in the administration of plentiful nourishment, cod-liver oil, iodide of iron, and other drugs of which iodine forms the chief constituent. The bromides of ammonium and potassium also enjoy the reputation of reducing enlarged tonsils. Locally, they should be treated with iodine dissolved in glycerine, or with the simple tincture, every other day. They should not be removed in children under the age of puberty, as frequently after that period they decrease spontaneously. In adults, if they cause much inconvenience, they should be excised, but not otherwise.

4. **Tonsillary Calculus.**—When two or three neighbouring follicles of a tonsil, as well as the interstitial tissue, are destroyed, the cavity thereby created pours out a greatly altered secretion, the product varying in consistence from a creamy pulp up to a calcareous deposit, of a white or yellow colour. This, on examination, has been found to consist of albumen, phosphate, carbonate, and oxalate of lime, with some animal matter. Some authors regard these calculi as the 'resolution of tuberculous deposits in the tonsils, which subsequently give rise to inflammation, suppuration, and ejection.'

Claud Muirhead.

**TOOTHACHE.**—Synon.: Fr. *Odontalgie; Mal de Dents*; Ger. *Zahnweh.*—Pain in connection with the teeth. *See* Teeth, Diseases of.

**TOOTH-RASH.** *See* Dentition, Disorders of.

**TOPHUS** (*tophus*, sand).—A term for the concretions which are met with in gout, in connection with the joints and other structures. It is also sometimes applied to gravel, and to the collection of tartar on the teeth. *See* Gout.

**TOPICAL** (*τόπος*, a place). *See* Local.

**TORMINA** (Lat. *griping*).—This word is applied to severe griping or colicky pains in the abdomen, due to flatus and other causes. *See* Colic; and Intestines, Diseases of.

**TORPOR** (Lat. numbness).—Synon.: Fr. *Torpeur*; Ger. *Torpidität.*—A condition of inactivity, bodily and mental, which may be met with in certain brain-diseases or febrile states, more especially in aged persons. The cerebral condition associated with torpor is an unnatural state of consciousness, closely allied to that known as stupor.

**TORQUAY, in South Devon.**—A mild, rather relaxing, and sedative marine climate. Sheltered from W., N., and E. winds. Mean winter temperature 44° Fahr. *See* Climate, Treatment of Disease by.

**TORSION** (*torqueo*, I twist).—This word signifies a twisting, and is used in the following associations:—

1. In relation to certain hollow organs, it indicates a form of displacement in which an organ

is twisted on itself, a condition especially noticed in connection with the intestines. It gives rise to more or less narrowing of the canal, and may close it completely, so as to cause absolute obstruction. Torsion also interferes with the circulation, thus leading to congestion, inflammation, or ultimately even to gangrene. *See* INTESTINAL OBSTRUCTION.

2. As a method of treatment, torsion is employed in checking arterial hæmorrhage, the ends of the bleeding artery being seized by the aid of suitable forceps, and twisted. It is chiefly used in bleeding from small arteries, but may prove efficient even when arteries of some size are the source of the hæmorrhage.

FREDERICK T. ROBERTS.

**TORTICOLLIS** (*tortum*, twisted, and *collum*, the neck).—A synonym for wryneck. *See* WRYNECK.

**TORULA.**—DESCRIPTION.—Torula is a form of microscopic fungus, belonging to the order *Saccharomycetes*, of the class *Protophyta*, which is the lowest division of *Thallophyta* (Sachs). It consists of round or ovoid cells, of an average diameter of about $\frac{1}{3000}$ inch, without nuclei, but composed of masses of vacuolated protoplasm, confined within a definite cell-wall. Occasionally they are free, but they are frequently associated into branching chains. *See* MICROSCOPE IN MEDICINE.

SOURCES.—Vinous, acetous, and other fermentations are due to the presence of low organisms, of which the 'yeast plant,' *Mycoderma* or *Torula cerivisiæ*, is the best known. Certain varieties of torula are of constant occurrence in the alimentary canal, and would seem to be normally associated with intestinal digestion. In those cases of vomiting where the ejected matters ferment, torulæ are always to be found, together with sarcinæ. These bodies are also of frequent occurrence in diabetic urine, if left standing; but they have also been found in non-saccharine urine. The pathological significance of torula, if any, is not known. W. H. ALLCHIN.

**TOUCH, Disorders of.**—SYNON.: Fr. *Troubles du Tact*; Ger. *Stöhrungen des Tastsinnes.*—The sense of touch may be considered as a compound of four distinct senses, namely, those of contact, pain, temperature, and muscular activity; and it is not necessary that all of these should be affected simultaneously or in an equal degree. Sometimes but one is the seat of disorder, and occasionally only one escapes. The lesion producing tactile disorder may be in any part of the sensory apparatus—in the peripheral end-organ in the skin which receives impressions, in the trunk of the nerve which conveys them, or in the central ganglion, the reaction in which is represented in consciousness as feeling. For the most part disorders of touch must consist either in a defective or in an unnaturally heightened reaction to impressions—conditions which are termed respectively *anæsthesia* and *hyperæsthesia.* But there are besides certain abnormalities of sensation which cannot be referred to either of these categories, as, for example, when a touch causes a sensation of burning, or the electric current is felt as something cold, and in these circumstances the term *paræsthesia* is used.

1. **Increased sensibility.**—DESCRIPTION.—It is doubtful whether the sense of touch proper, the power of tactile discrimination, is ever morbidly *increased*, except possibly in certain cases of hysteria and mental disorder. The term *hyperæsthesia* would be properly applied to such a condition instead of, as it is more commonly used, to excess of sensibility to painful impressions, which is perhaps better called *hyperalgesia.* In cutaneous *hyperalgesia* even a light touch upon the skin produces more or less exquisite pain. The patient often cannot even wash the skin, which is described as feeling raw or sore to the touch. The symptom frequently occurs in connection with neuralgia (especially of the trigeminal nerve), and in hysteria, as well as in the various forms of local inflammation. It may precede by some days the characteristic pains of neuralgia; is often associated with excess of sensibility to heat and cold; and usually with diminution of sensibility of the tactile sense proper. It is seen in its severest form in connection with gunshot injuries of nerves.

There may be heightened sensibility to *temperature*, either as regards heat or cold singly, or in respect to both at the same time. This symptom is observed in connection both with peripheral and central disease, as an accompaniment of neuritis, as well as of degenerative changes in the cord or cerebral ganglia. It is often, but not always, associated with *hyperalgesia.*

Heightening of the sense of *contact* is rarely observed, and is of but little practical importance. Perhaps the condition known as 'fidgets' is best explained as depending upon a heightened sense of *muscular activity.*

TREATMENT.—So far as is practicable, the lesion which is the cause of hyperalgesia, whether peripheral or central, must be discovered and become the subject of treatment. But the symptom itself may be mitigated by appropriate means. Such are the local application of moist heat by fomentation or poultice; of cold, by means of ice; or of anodynes, such as veratria ointment somewhat diluted, or atropia ointment; or the hypodermic injection of morphia (gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$). Spongiopiline may be sprinkled with a liniment composed of chloroform one part and belladonna liniment three parts; or equal parts of ether, sal volatile, laudanum, and eau de Cologne may be applied. A piece of lint soaked in chloroform may be laid upon the painful portion of skin and covered with oiled-silk, or the part may be rubbed with camphor-chloral and vaseline, equal parts; or painted with amyl-colloid. The application of one pole of the continuous current to the hyperalgesic spots, whilst the other is placed on an indifferent part, will often be of service, the power of bearing a gradually increased strength showing the improvement produced. Hysterical hyperalgesia can sometimes be successfully treated by the application of a strong induced current, by means of the wire brush, the patient, if necessary, being placed under the influence of ether.

2. **Defective sensibility.**—DESCRIPTION.—Cutaneous anæsthesia may result from local ab-

straction of heat, as from exposure to a very low temperature. In such a case anæmia is produced, from spastic contraction of blood-vessels, followed by hyperæmia from their secondary relaxation. In the anæmic stage, whilst the other tactile sensations are lowered, that of temperature is heightened. Deficient sensibility may be caused by irritating applications, such as soda used by laundresses, and various chemicals employed in the arts. In such cases there is numbness in the hands and forearms, with a sensation of 'going to sleep' in the fingers. It may occur in connection with *herpes zoster*, the skin between the groups of vesicles being often partially anæsthetic. In *lepra anæsthetica*, in which there are enlargements of the cutaneous nerves, the senses of temperature and pain are often abolished, and severe burns may take place without being recognised. Anæsthesia may be produced by pressure upon sensory or mixed nerves, by syphilitic and other growths in adjacent tissues. Narcotics, as chloroform and ether, may quell the sense of pain, that of contact being, to a certain extent, retained. Wounds and lacerations of the sensory or mixed nerves, followed by inflammatory processes, may, by irritating, cause pain to precede the anæsthesia, arising from the interruption of conductivity in the nerve-fibres. Simple mechanical pressure upon a nerve, if long continued, will often, especially if its nutrition be impaired by constitutional causes, excite a low inflammatory condition. In traumatic cases, as also in lepra anæsthetica and in cases of new growths pressing on the nerve, motor and nutritive disturbances are apt to accompany the anæsthesia, the nerve-trunks conveying not only sensory, but also motor, vaso-motor, and trophic fibres. Severe trophic disorder is usually associated with the anæsthesia occasioned by lesion of the fifth nerve; and to a less extent with that accompanying trigeminal neuralgia. *See* Trifacial Nerve, Diseases of.

Preceding attacks of neuralgia, the skin of the part about to be affected is often found to be anæsthetic, and during attacks of sciatica and cervico-brachial neuralgia there is often much diminution of tactile sensibility, severally in the foot and lower part of the leg, and in the fingers; whilst the skin around the eye may be greatly deficient in tactile sensibility during severe supra-orbital neuralgia. It is important to discriminate anæsthesia of the skin caused by disease of the nervous centres, from that which is of peripheral origin.

Cutaneous anæsthesia is occasionally an important symptom of an approaching cerebral hæmorrhage. A sudden and increasing numbness is experienced in one half of the face, or in the limbs on one side of the body, which may be followed shortly by coma and hemiplegia. An apoplectic seizure usually causes unilateral cutaneous anæsthesia, which is at first widely diffused, owing probably to the disturbance of circulation in, and consequent disarrangement of the nervous molecules, which extends at first far beyond the site of the effusion. A few hours or days usually suffice for the clearing off of this anæsthesia, leaving, however, a subjective feeling of numbness, which may endure for a longer or shorter period.

The extent of anæsthesia bears no necessary relation to the amount of motor paralysis. It usually affects the paralysed side of the body, but in certain cases of hæmorrhage into or other lesion of the medulla oblongata and pons varolii, it may occupy the opposite side. Complete hemi-anæsthesia of central origin may persist long after the paralysis of motion has disappeared, and in such a case a lesion is likely to be found in the outside of the optic thalamus, involving the internal capsule. Occasionally, too, hemi-anæsthesia may from the first be unaccompanied by motor paralysis. Much more frequently, however, cutaneous anæsthesia (except for the first few hours) is of comparatively slight and transitory character, even in cases where there has been extensive disorganisation of the brain from hæmorrhage or softening, and where the resulting paralysis of the muscles is complete and permanent. It may be absent altogether from the first, but this is not common, except in cases of cortical lesion of the brain. Recovery is gradual, and proceeds from the nervous centre downwards, the fingers sometimes retaining slight anæsthesia long after the rest of the arm has entirely recovered. Cerebral tumours may give rise to cutaneous anæsthesia by pressure upon the Gasserian ganglion, or upon the trunk or branches of the fifth nerve as they traverse the floor of the skull. Like the motor paresis or paralysis which may be occasioned at the same time, the loss of sensibility is usually, but not always gradual, tending to increase rather than to diminish as time goes on. It is not usually a prominent symptom in cerebral abscess.

Lesion of the spinal cord or its membranes may give rise to cutaneous anæsthesia, which is frequently, in the lower extremities, extensive and complete; but it may be absent when—as, for example, in very advanced sclerosis of the antero-lateral columns—there is complete paraplegia. A varying amount of cutaneous anæsthesia, especially affecting the soles of the feet, is apt to occur in progressive locomotor ataxy. Anæsthesia of spinal origin is usually bilateral; but it affects that lower extremity alone which is opposite to the one paralysed in its motility, when the causative lesion is limited to one half of the cord. Intercurrent complications from disturbances of circulation, the temperature of the limb, the extension or subsidence of inflammation, and the effusion of inflammatory products about the posterior roots, as well as the spread of sclerotic changes, may cause the extent and completeness of cutaneous anæsthesia to vary considerably in cases dependent upon spinal cord disease. Where the lesion lies tolerably high up, tickling the soles of the feet, although quite unfelt by the patient, is able to excite the motor nerves, and produce reflex muscular contractions, which the loss of muscular sense prevents him from recognising. It is extremely important to remember that cutaneous anæsthesia of spinal origin is liable to be associated with bed-sores. In certain cases, where probably trophic and vaso-motor nerves have been included in the lesion, this liability is excessive, and may defy all precautions.

Loss of the *sense of muscular activity* may

occur in an isolated form, the other modes of tactile sensibility being unaffected; or it may be associated with impairment of some or all of them. The symptom is especially notable in progressive locomotor ataxy (*see* LOCOMOTOR ATAXY). It may also occur in connection with paresis resulting from coarse disease of the occipital lobe of the cerebrum. Loss of muscular sense may accompany hemiplegia, attended with strongly marked and prolonged anæsthesia, from disease of the optic thalamus. It occurs sometimes in hysteria. There is a form of anæsthesia occasionally met with in hysteria which it is important to recognise, so as not to confound it with a somewhat similar condition resulting from disease of the neighbourhood of the optic thalamus. In this the patient may lose the power of perceiving impressions of contact, temperature, and pain throughout the whole of one lateral half of the body, sharply divided from the sound side by a line passing downwards from the vertex to the os pubis. Accompanying this *hemianæsthesia*, as it is called, there is often amblyopia and colour-blindness of the corresponding eye, loss of taste and smell, together with tenderness on deep pressure over the region of the ovary on the same side. In some cases, too, the skin is unnaturally pale and cold, and pricks with a pin are said to be not followed by bleeding, which readily takes place in corresponding circumstances on the opposite side of the body.

DIAGNOSIS.—As regards both hyperæsthesia and anæsthesia the most important consideration, after establishing the existence of either, is as to whether the cause be central or peripheral. It is impossible to do more than indicate the general principles upon which this inquiry is to be conducted. The patient's history, the condition of viscera and circulation, the existence or not of accompanying paralysis or of modifications of the organs of special sense, will lend important aid. As a rule, the anæsthesia of central origin is much more widely diffused, though less complete, than that dependent upon lesion of nerve-trunks, when it is also often accompanied with localised atrophy of muscles or other trophic disturbance. It is very rare that hemianæsthesia of central origin is so complete as the hysterical, and it is not accompanied, like the latter, with tenderness on deep pressure over the ovarian region. There is no doubt that hyperæsthesia has often been mistaken for localised inflammation, and treated accordingly. The absence of febrile movement, and the fact that it is mainly upon light surface-touching that the exquisite tenderness occurs, which fails to be felt when deeper pressure is made, coupled with the history, and a study of the concomitant condition, ought to suffice to prevent all mistakes.

TREATMENT.—Anæsthesia is a symptom of a lesion either in the central nervous system or in a peripheral nerve, and its treatment is bound up with that of the disorder which gives rise to it. But there are many cases in which, apparently as a result of disease, the sensory nerves fail to convey impressions for a considerable time after the lesion which interfered with their function has been healed. In such circumstances very much good can often be done by electrical treatment. The skin, carefully dried, should be brushed over for a few minutes every day with the wire brush, connected with an induction machine; or the well-wetted rheophore connected with the negative pole of a constant current battery may be slid about over the affected surface, well moistened with hot water. In hysterical anæsthesia the application of various metals (gold, silver, copper, tin, lead, iron—one or other of these), has been found very successful in the hands of Drs. Burq and Charcot, of Paris, and a trial of them in appropriate cases should not be omitted. The metal should be closely applied to the affected skin for ten minutes at a time.

Static electricity is a valuable means of combating anæsthesia of this kind. The patient, seated on an insulating chair, is connected by a conducting chain with a frictional electrical machine, and sparks are drawn from the affected surface.

3. Paræsthesia.—DESCRIPTION.—The varieties in disorder of the different kinds of tactile sensibility—touch, pain, temperature, muscular activity—are very numerous. Pinches or pricks with a needle may be felt as touch only, whilst a very light touch with the finger is appreciated as touch. Strong faradaic currents (intolerable to the healthy) may be felt as cold. Heat may be felt as cold, but kept still longer applied may be recognised as heat or warmth. A limb plunged into hot or cold water may get the feeling, not of heat or cold, but of pain. To such modifications, as well as to feelings of burning or cold, tingling, creeping of ants, or actual numbness, the term *paræsthesia* is often applied. A seamstress may be able to pick up and thread her needle, evincing thereby considerable delicacy of sense of contact, and yet be scarcely able to feel a prick of a needle in the finger-tip. Or the sense of contact may be in abeyance, as well as that of pain and temperature, and the movements may be then guided by the sense of muscular activity, aided by sight.

T. BUZZARD.

**TOXÆMIA** (τοξικὸν, a poison, and αἷμα, blood).—This word literally signifies poisoning of the blood. It is not employed with any very strict or definite meaning, but most commonly implies blood-poisoning due to some pathological condition within the body itself, in contradistinction to that which results from the introduction of the ordinary poisons from without. As illustrations of toxæmic states may be mentioned pyæmia and septicæmia; uræmia; and acetonæmia, upon which, according to some authorities, the comatose condition which precedes the fatal issue in some cases of diabetes depends. The accumulation of bile in the blood, in cases of jaundice, is also a form of toxæmia. The morbific agents which are supposed to produce the several infectious and malarial fevers are likewise regarded by many as originating toxæmic conditions; as are also those which originate such affections as gout and rheumatism. These subjects will be found discussed under their several headings. FREDERICK T. ROBERTS.

**TRACHEA, Diseases of.**—SYNON.: Fr. *Maladies de la Trachée*; Ger. *Krankheiten der*

*Luftröhre.*—The trachea is but little prone to disease, except in association with affections of the larynx, bronchi, and neighbouring parts. The diagnosis and treatment of these several diseases is greatly facilitated by the laryngoscope. With this instrument a skilful manipulator can in many cases examine the trachea in its whole length, and an accurate diagnosis being thus attained, remedies may be applied, and instruments may be introduced for the removal or destruction of growths, or for other purposes, either through the larynx, or by an artificial opening made in the trachea. The principal morbid affections of the trachea will be discussed in the following order:—1. Malformations; 2. Inflammation; 3. Ulceration and Perforation; 4. Syphilis; 5. Tuberculosis; 6. Tumours; 7. Stenosis; and 8. Foreign bodies.

1. **Malformations.**—Defects in the development of the trachea occur as rare causes of the death of newly-born infants. The tube may be short and imperforate; or communication may exist with the œsophagus. These conditions are necessarily fatal. A fistulous opening through the skin occasionally occurs, giving rise to no serious symptoms. *Tracheocele*, a hernia of the mucous lining of the trachea, is a rare malformation, easily recognised, which may arise from a congenital defect, but is more frequently acquired.

2. **Inflammation.**—Tracheitis, simple, specific, or diphtheritic, may result from the extension of inflammation, either from the larynx above, or from the bronchial tubes below; it is rare except in this connection. Some degree of congestion is a usual condition of ordinary catarrh; and chronic tracheitis is a frequent cause of the cough of old people. *See* Bronchi, Diseases of; Diphtheria; and Larynx, Diseases of.

3. **Ulceration and Perforation.**—Ulceration and perforation of the walls of the trachea may result from the pressure of an aneurism, which ends by bursting into the air-passages, where it meets with least resistance; or from an abscess which has taken a similar course.

4. **Syphilis.**—Syphilis, in its secondary and tertiary stages, may affect the trachea. In the tertiary stage it gives rise to ulcers, which contract in healing, and cause a formidable condition of stricture, to be presently considered. Tracheal syphilis, being in its advanced form so grave a matter, calls for active constitutional treatment before this irremediable stage is reached.

5. **Tuberculosis.**—Tubercle occurs in connection with laryngeal and pulmonary phthisis. When the disease has proceeded to ulceration, it may cause the rare complication of general emphysema, the air being forced into the cellular tissue by cough and other expiratory efforts, made when the larynx is closed.[1]

6. **Tumours.**—(*a*) *Cancer.*—Cancer of the trachea as a primary disease is almost unknown, but the organ is frequently affected by the extension of the disease from neighbouring organs. The growth first causes the symptoms of stenosis; and then, as ulceration proceeds, it gives rise to expectoration and other symptoms. The diagnosis will not be difficult. The only treatment available for prolonging life is tracheotomy, if the seat of the disease is high enough to admit of it. (*b*) *Non-malignant growths.*—Polypi are very rare. The symptoms are those of obstructed breathing, modified by the size and seat of the growth. A certain diagnosis can be attained only by tracheoscopy. Without treatment, a polypus is almost certain to cause death by suffocation, its rate of growth depending on its pathological nature. Small growths situated high up may be treated by the galvano-cautery or by other applications through the larynx; larger tumours can only be removed through a free opening made into the trachea. A tumour may be so situated that tracheotomy, without extirpation, may ensure the safety of the patient.

7. **Stenosis.**—The calibre of the trachea may be lessened (*a*) by *stricture*, or by *tumours growing within it*; or (*b*) by *pressure from without.*

(*a*) *Stenosis from true stricture, or internal tumour.*—Stricture is almost always a result of syphilis; it may be annular and limited, but it usually involves the tube for some length. Tracheal narrowing, is indicated by obstructed breathing, with hissing inspiratory dyspnœa, unaccompanied by the up-and-down movement of the larynx, and the affection of the voice characteristic of laryngeal dyspnœa, and also without the stethoscopic signs of pressure on, or plugging of, a bronchial tube. Under these circumstances, and in the absence of any tumour in the neck or thorax pressing on the trachea, the stenosis must depend on a stricture, or on a tumour within the tube. A syphilitic history would lead us to diagnose the former; and a tracheoscopic examination, if practicable, would make the diagnosis certain.

Prognosis.—Stricture being usually cicatricial, the prognosis is most unfavourable.

Treatment.—Treatment other than operative is seldom available. If the stricture be high up, tracheotomy must be performed below it; or, an opening being made above the contraction, a long flexible tube may be introduced and passed through it. Stricture of the trachea is less amenable than laryngeal stenosis to treatment by mechanical dilatation with hollow bougies, but this method must be borne in mind for exceptional cases.

(*b*) *Stenosis from compression.*—The source of stenosis caused by pressure from without is usually patent, thoracic tumours being diagnosed by their physical signs and concomitant symptoms. The paroxysmal dyspnœa frequently caused by these tumours is usually laryngeal, depending on pressure on the recurrent nerve; but in some cases it is a peculiar result of pressure on the trachea. It is not relieved by tracheotomy, and is akin apparently to the paroxysmal dyspnœa occasionally seen as a result of pressure by the tampon-tube used after tracheotomy, for plugging the trachea in certain operations.

8. **Foreign bodies.**—A foreign body entering the air-passages from the pharynx, may lodge in the larynx, either becoming impacted or lying loose. But, unless prevented by its form or bulk, it usually falls or is drawn through the open glottis into the trachea. Here it may

[1] The writer recently examined *post mortem* the body of a child (the patient of Dr. W. M. Craig) which had died of acute tuberculosis, and in which this rare phenomenon had resulted from an ulcer of the right bronchus, situated immediately beyond the bronchial spur.

lodge; but it more frequently passes on into one of the bronchial tubes—most frequently into the right bronchus, the orifice of which is slightly larger than that of the left, and occupies more of the floor of the trachea.

Symptoms. — Occlusion of the larynx by a foreign body, which from its bulk obstructs the passage, may cause instant death; and the same may be said of the trachea, as when a person vomiting, in a state of unconsciousness from intoxication, or from the action of an anæsthetic, draws in a quantity of food sufficient to choke up the air-passages. If the body be smaller, it causes dyspnœa, with severe exacerbations from spasm. A very small body, such as a sharp piece of bone or a pin, may be impacted in a position in which it causes only pain and dysphagia without dyspnœa. Speaking generally, it may be said that when the substance has passed into the trachea, the symptoms to which it gives rise depend on its bulk and weight. Rarely, it lies in the air-passages, giving rise to no symptoms; more frequently, varying its position with the rush of air in coughing, &c., it gives rise to paroxysmal dyspnœa, light bodies being forced up to the glottis and exciting spasm. If the substance pass into the bronchus, it may become impacted there, and will give rise to characteristic physical signs, usually exciting a chronic circumscribed inflammation, with symptoms akin to pneumonic phthisis.

Treatment.—From the larynx a foreign body may be removed by the finger or a suitable forceps, its presence having been determined from the symptoms, aided by digital or laryngoscopic examination. Although different forms of long forceps are made for passing through the larynx into the trachea, it is seldom practicable to remove *per vias naturales* a foreign body which has once passed through the rima. A free opening must be made in the trachea, and its edges held well asunder, to give a chance of the body being expelled by cough. If this fail, a forceps must be introduced through the opening, and the body, if possible, extracted. Inversion of the patient, so as to allow a heavy substance to fall back through the glottis into the pharynx, is sometimes successful, but not as a rule without previous tracheotomy. T. J. Walker.



**TRANCE** (*transitus*, a going beyond—of the soul from the body).—Synon.: Lethargy; Fr. *Léthargie; Maladie du Sommeil*; Ger. *Schlafsucht.*

Definition.—A sleep-like state, which comes on spontaneously, apart from any gross lesion of the brain or toxic cause, and from which the sleeper cannot be roused.

The term 'trance,' in its derivative meaning, aptly expresses the apparent reduction to a vegetative life, but the popular use of the word refers rather to the separate activity of the mind than to the inactivity of the body. Hence many writers prefer the term 'lethargy,' which also, although etymologically exact, is currently employed in a modified sense. The condition is sometimes included under the generic term 'catalepsy,' according to its etymological meaning, 'a seizing'; but this term is usually restricted to those forms which present a peculiar rigidity. It may be noted that the terms trance and catalepsy are both due to the theories of a mythical pathology.

The ordinary forms of trance will be first described, and afterwards the peculiar variety of 'sleeping-sickness' which is met with on the West Coast of Africa.

Ætiology.—The influence of heredity in relation to trance is to be traced only in the production of a 'neuropathic disposition.' It occurs chiefly in the female sex, between the ages of twelve and thirty; very rarely in young men or children. The subjects are seldom in perfect health; they usually present other manifestations of hysteria, and are often anæmic. The condition is rare, however, even in hysteria. Of a large number of hysterical patients which have come under the writer's notice, only two presented spontaneous trance. The condition has been in some cases apparently due to exhausting diseases, as typhoid fever, excessive brain-work, insolation, or mechanical obstruction to the supply of blood to the head. The immediate exciting cause is usually emotional disturbance. In rare cases, in which trance has followed traumatic influences, the mechanism has probably also been psychical. In several cases, trance has succeeded an hysterical convulsion. Rarely no exciting cause may be discoverable. In still more rare instances the state has been voluntarily induced, as in the well-known case of Colonel Townsend, who could throw himself into a condition of apparent death, lasting several hours. Such voluntary induction is occasionally seen in the East. Lastly, minor degrees of trance may, without difficulty, be artificially produced in most hysterical persons, and less readily, in many others, by the methods described in the article on Hypnotism. The state now designated hypnotism is really induced trance, and trance has been accurately termed 'spontaneous hypnotism.'

Symptoms.—The onset of the state of trance is usually sudden. For instance, in a case which came under the writer's notice, a girl went into a room by herself, and was found, shortly afterwards, in a state of trance-sleep, which lasted for thirty-eight hours. In another case (Madden) a young lady went into a room to change her dress, and was presently found on the bed in a state of trance which lasted for a fortnight. As already stated, it may succeed an hysteroid convulsion, and in some other cases the onset has been attended with an aura, resembling the globus hystericus or the sensation which precedes hysteroid and epileptic fits, as of a ball rising from the abdomen to the throat. In the cases which succeeded typhoid fever (Madden) the delirium of the fever passed gradually into comatose sleep, which continued for several weeks.

During the state of trance, the countenance is usually extremely pale. The limbs are relaxed, although brief initial rigidity, and sometimes occasional recurrent cataleptic rigidity, or transient convulsive spasms, tonic or clonic, have been noted. In a few instances distinct hysteroid fits have occurred from time to time during the course of the trance. The eyelids are usually closed, and may resist and quiver on attempts to open them. The eyeballs are directed upwards

in most cases; they often deviate from the middle line, and sometimes diverge slightly. The pupils are usually moderately dilated; rarely they are moderately contracted. The state of reflex action varies according to the depth of the trance. That from the limbs is sometimes excessive, so that cutaneous stimulation produces tetanic rigidity. Much more frequently reflex action is lost; snuff blown into the nostrils causes no sneezing, ovarian compression has no effect, and pressure on hysterogenic points, which may have existed before, no longer causes the usual phenomena. Reflex action from the conjunctiva, and even from the cornea, is commonly absent. The pupil may contract to light, but in lessened degree, and sometimes no distinct action can be observed.

The mental functions seem, in most cases, to be in complete abeyance. No manifestation of consciousness can be observed, or elicited by the most powerful cutaneous stimulation, and on recovery no recollection of the state is preserved. But in some cases volition only is lost, and the patient is aware of all that passes, although unable to give the slightest evidence of consciousness. The senses may be even preternaturally acute, as in the analogous phase of induced hypnotism; or there may be spontaneous mental action, irrelevant to external impressions, and analogous to, probably identical with, the state of ordinary dreaming; it is manifested by exclamations, and even by movements. Rarely the 'obedient automatism' seen in induced hypnotism may be present; hallucinations occur, and actions are performed, according to suggestions made to the patient. The usual condition, however, is that of an entire absence of all evidence of mental activity.

The pallor of face is the result of a profound depression of the vascular system. The pulse may be less frequent or more frequent than normal, but it is invariably weaker, and it may be imperceptible. The cardiac impulse may disappear, although the heart-sounds are still to be heard, sometimes much weakened. Very rarely they have been inaudible. In a case observed by Weir-Mitchell, vascular disturbance preceded the other symptoms. The breathing during trance may be tranquil, slightly quickened, or slower, or may be so feeble and deliberate that no movement of the thoracic walls can be observed, no respiratory murmur can be heard in the lungs, and a mirror held over the mouth is undimmed by moisture. Rarely respiration presents rhythmical variations. Temperature, when observed, has been normal in the central parts, lowered at the periphery. The secretions go on; the urine may be retained in the bladder, or passed into the bed. The catamenia are usually absent, but menstruation has been known to occur without modifying the course of the trance-sleep. In the cases in which the depression of the vital functions reaches an extreme degree, the patient appears dead to casual and sometimes to careful observation. This condition has been termed 'death-trance' (*Scheintod*), and has furnished the theme for many sensational stories, but the most ghastly incidents of fiction have been paralleled by well-authenticated facts.

Duration and Course.—The duration of trance has varied from a few hours or days, to several weeks, months, or even a year. When of short duration, the trance-sleep may be unbroken, but when it lasts for more than a few days, there are usually remissions of a greater or less degree, in which, for instance, the patient will half-wake, take food in an automatic manner, and then relapse into stupor. A long trance-sleep may be more profound at first than later. Recovery may be sudden or gradual. Occasionally it is attended by some vaso-motor disturbance; in a well-authenticated case of death-trance the intense mental excitement produced by the preparations for fastening the coffin-lid occasioned a sweat to break out over the body. In other cases hæmorrhages have occurred at the time of recovery, and such extravasations in the skin have been regarded as legendary 'stigmata.' After the trance is over, nervous prostration, with defective articulation, or mental dulness, may remain for a time. In many cases repeated attacks of trance occur, at intervals of days, months, or years. Most cases of trance-sleep end favourably. The depression of the vital functions enables life to continue with a very small amount of nourishment. Occasionally death occurs, as in the case of a deserter from the German army, and in one of the cases after typhoid fever described by Madden.

Pathology.—The very few *post-mortem* examinations which have been made after death in trance, throw no light on its nature. The theoretical pathology of the subject is involved in the obscurity which envelopes all the psychical processes in health and disease, the nature of volition, and ordinary sleep. The lowered action of the brain in sleep, and its lessened blood-supply, have suggested the existence of cerebral anæmia, which the meagre results of anatomical investigation have been supposed to confirm. It is certain that the condition is sometimes associated with defective cerebral nutrition; but that much more than cerebral anæmia is needed to explain the state of trance, is evident from the facts that, on the one hand, it may occur when there is no preceding sign of defective blood-supply to the brain, while, on the other hand, the occurrence of cerebral anæmia without trance-sleep is a matter of daily observation. The phenomena of hypnotism also afford little support to the theory of the dependence of trance-sleep on cerebral anæmia, but, beyond this, they throw no light on its pathology. The subject affords abundant scope for theories, which have been freely supplied, but are, for the most part, mere re-statements of the observed phenomena, in the language of psychology.

Diagnosis.—The diagnosis of trance rests on the impossibility of rousing the sleeper, combined with the absence of any evidence of a local cerebral lesion or a toxic cause. Other diagnostic symptoms are the pallor and vascular depression, the occurrence of convulsive phenomena of hysteroid type, and the history of other manifestations of hysteria. These symptoms sufficiently distinguish trance-sleep from apoplexy, for which, at the onset, it is sometimes mistaken. The distinction from catalepsy rests on the absence of the *flexibilitas cerea*, but cata-

lepsy is merely a variety of trance. The peculiar tendency to brief sleep termed *narcolepsy* is distinguished from trance by the shortness of the periods of unconsciousness. Thus a man had from youth fallen asleep for a few minutes under various influences, and always did so when a probe was passed down a nasal fistula. It is to be remarked, however, that the term *narcolepsy* has been also applied in America to cases of true epilepsy, in which the attacks of *petit mal* are characterised by sudden somnolence.

In cases of 'death-trance,' in which no sign of vitality can be recognised, the presence of life may be ascertained (1) by the absence of any sign of decomposition; (2) by the normal appearance of the fundus oculi as seen with the ophthalmoscope; (3) by the persistence of the excitability of the muscles by electricity. This excitability disappears in three hours after actual death. In a case observed by Rosenthal, thirty hours after supposed death the muscles were still excitable, and in forty-four hours the patient awoke. *See* DEATH, Signs of.

PROGNOSIS.—In cases of hysterical lethargy the prognosis is fairly good. The attack usually passes off. In very rare cases death has occurred. The slighter the degree of the trance, the shorter is likely to be its duration. The prognosis is grave only when the lethargy has been preceded by a state of great physical depression, and is the most serious when the condition succeeds an acute disease.

TREATMENT.—The treatment has to be directed to two ends: the maintenance of life, and the arrest of the trance. Advantage must be taken of any intervals of semi-consciousness to give nourishment in a concentrated form. If swallowing is continuously impossible, food must be given by the nasal tube, or by enemata. Warmth should be applied to the extremities, and care taken to prevent bed-sores. In severe cases, every attempt at arrest is often fruitless. Errhines, as snuff, have usually no influence, and it is only in slight cases that this, or stimulation of the skin, as by sinapisms, is effective. The most powerful cutaneous excitant is strong faradisation. In a case under the writer's notice, which had lasted for thirty-six hours, strong faradisation to the arm quickly roused the patient. In another case, which lasted for several months, this treatment had, for a long time, no influence; afterwards the patient could be partially roused for a short time by faradisation, and by repeating the application at the same hour every day, a tendency to periodical waking was established, the remissions became longer and more complete, and the attack was ultimately brought to an end. Nervine stimulants, such as ether and valerian, may be given by the bowel, or sulphuric ether may be injected subcutaneously. Alcohol must be given with caution and in small quantities; enemata of strong coffee are often more useful. A remedy which, from its effect on the vascular system, would certainly deserve trial in trance, is the inhalation of nitrite of amyl. Transfusion of blood has been proposed, and would be justified in cases following exhausting disease. The recurrence of attacks must be prevented by the improvement of health, physical and moral.

**African Lethargy.**—The 'sleeping sickness' of the West Coast of Africa is met with chiefly in the Congo and Sierra Leone regions, and affects exclusively negroes. It occurs in both sexes and at all ages, but is most frequent in males between twelve and twenty. Except that depressing emotions seem to predispose to it, the proximate causes are entirely unknown. Europeans, living in the same localities, are exempt. Swelling of the cervical glands sometimes occurs at the onset, and they are excised by the native doctors as a remedial measure; but the condition is not invariable, and its influence is doubtful. The general health may be perfect. The symptoms differ considerably from those of hysterical trance. There is a gradually increasing tendency to somnolence. The patient will fall asleep at his work or over his meals. At first he can be roused, and if treated by cutaneous stimulation and purging, the symptoms may be removed for a little time; but they soon recur, and increase in spite of treatment, until at last the patient is always asleep, and refuses food. He gradually emaciates, and dies at the end of three or six months from the onset of the symptoms. Just before death the disposition to sleep often ceases. The disease is extremely fatal. Guèrin met with 148 cases, all of which died. The observations of Gore and others place the mortality somewhat lower—at about 80 per cent. *Post-mortem* examination has revealed only hyperæmia of the arachnoid, slight signs of chronic meningitis, but no considerable excess of fluid within the ventricles or outside the brain. The cerebral substance is usually pale. No treatment appears to influence the symptoms. Only one observer (McCarthy) has seen good from excision of the cervical glands. This mysterious affection clearly needs more systematic investigation than it has yet received.

W. R. GOWERS.

**TRANSFUSION OF BLOOD.**—SYNON.: Fr. *Transfusion du Sang*; Ger. *Transfusion des Blutes.*

DEFINITION.—The injection of blood from the human subject or from one of the lower animals, in a pure or defibrinated condition, into the veins of a patient.

DESCRIPTION.—This operation was invented in the middle of the 17th century, and is now fully established as a proceeding of great value; but authorities are still divided as to the best mode of performing it. Transfusion is most frequently undertaken as a means of saving life after a great loss of blood, and most commonly after *post-partum* hæmorrhage. It has also been employed in cases of profound anæmia from other causes, as in leucocythæmia, phthisis, and 'pernicious anæmia,' and its use has been suggested in the so-called blood-diseases, as fevers or pyæmia, but the benefit derived from it in these cases is at most only temporary, and it is probable that the operation will ultimately be limited to cases of anæmia from hæmorrhage. Transfusion benefits the patient, first, by increasing the quantity of fluid entering the ventricles, and so encouraging their action; secondly, by increasing the number of blood-corpuscles which, as the carriers of oxygen, are essential to life;

thirdly, by supplying albumen, and so giving nourishment at a time when it is probably impossible to do so by any other means. For none of these purposes is the fibrin of the blood essential, and consequently many operators prefer to defibrinate the blood, by which much trouble in the operation is saved. Experiments on the lower animals, and observations of operations performed on the human subject, seem at present to indicate that defibrinated blood is in every way as efficient as pure blood. Yet when all the necessary appliances are at hand, pure blood is undoubtedly the most natural fluid to inject. When human blood has not been available, the blood of a calf, a sheep, or a lamb has been used instead, apparently with equally beneficial results. The difference between the size of the corpuscles in these animals and in man is of no consequence, as those of man are the larger. The corpuscles from these animals probably break up very soon, as hæmatin has been found in the urine the day after transfusion with lamb's blood; but they no doubt serve as carriers of oxygen for a short time, during which the patient may rally. The dangers of transfusion are not very great, but as cases have occurred in which the donor of blood has died in consequence of the operation, it should not be undertaken without a clear prospect of benefiting the recipient. Care must be taken that air is not injected with the blood. The experiments of Oré (*Études historiques et physiologiques sur la Transfusion du Sang*, Paris, 1868) have, however, shown that this danger has been much exaggerated. A bubble of air does no harm; the quantity to cause death must be considerable. Too great care cannot, however, be taken to exclude air, as fatal cases have occurred from this cause. The injection of clots giving rise to embolism, and perhaps to pyæmia, is always considered one of the dangers of the operation; but evidence is wanting to show that it has been a frequent cause of death, or that in all the cases in which pyæmia or septicæmia followed the operation it was due to this cause. One case is recorded by Jürgensen (*Vier Fälle von Transfusion des Blutes*, Berlin, 1871) in which red maculæ formed on the skin after the operation, which subsequently suppurated. These were supposed to be due to minute fragments of fibrin injected with the defibrinated blood. Dr. Madge (*Brit. Med. Jour.* vol. ii. 1874; and *Obst. Jour. of Gt. Brit.*, 1874) has shown, however, that with care no such fragments need be left after whipping and straining. The wounds left after transfusion present nothing special, and are to be treated as ordinary venesection wounds. The difficulties with which the operator has to contend are not great when defibrinated blood is used. When pure blood is used by any but the immediate method of transfusion from artery to artery, or vein to vein, there is some necessary hurry, as the operation must be finished before coagulation sets in. To avoid this, Dr. Braxton Hicks recommends the addition of a solution of phosphate of soda (℥j to Oj), in the proportion of one of the solution to three of blood; and Dr. Richardson a solution of liquor ammoniæ (♏xx and distilled water ℥j), to be added to a pint of blood. Both these solutions have the power of arresting coagulation. There is often some difficulty in finding the collapsed and empty vein of the patient. An ordinary venesection incision is useless; the vein must be cut down upon, picked up with forceps, and then opened.

Transfusion is either *mediate* or *immediate*. In the *mediate* operation the blood may be either defibrinated or pure. When pure blood is used, the vein of the patient must first be exposed and opened, and a silver cannula introduced. It is better to use an assistant's fingers rather than a ligature to retain the cannula in its place. It is well to allow a drop or two of the patient's blood to escape from the cannula, if possible, to make sure it contains no air, or it may be filled with warm water or a solution of phosphate of soda. While this is being done the donor is bled into a clean vessel. No precautions need be taken to keep the blood warm. Cold delays coagulation. As soon as sufficient blood has been obtained, it is transferred to a syringe which is provided with an india-rubber tube. Care being taken that the tube and syringe contain no air, they are now connected with the cannula, and the blood slowly injected. Innumerable instruments have been invented for this operation, with the object of saving time, and ensuring against the entrance of air. It is impossible to describe them here. The best known are Hewitt's (*Brit. Med. Jour.* 1863, vol. ii.), Hicks's (*Guy's Hosp. Reports*, 1869), Higginson's (*Liverpool Med. Chir. Jour.*, 1857), and Mathieu's (*Bull. Acad. de Med.* Paris, 1867). In this last the blood is received directly from the donor into a funnel at the top of the syringe, and great rapidity of operation is consequently attained. An ingenious instrument, which it is impossible to describe without a drawing, was introduced into London in 1877 by Dr. J. Roussel. When all its parts are in good order it doubtless works extremely well, but it is somewhat complicated and uncertain in its action (Dr. J. Roussel on *Transfusion of Human Blood*, with a preface by Sir James Paget. London, 1877). When defibrinated blood is used, complicated instruments are unnecessary. The blood must be received into a clean vessel, and whipped with a clean stick or a twisted glass rod, till fibrin ceases to separate. The whipping must be done gently, so as not to injure the blood-corpuscles, or to break off minute fragments of fibrin. After whipping, the blood must be carefully strained two or three times through some clean linen. It may then be injected as above described. The operation of *immediate* transfusion has been reintroduced by Dr. Aveling (*Obst. Jour. of Gt. Brit.*, 1873). In this operation two cannulæ are required, one for the vein of the donor, and one for that of the patient. They are connected with each other by an india-rubber tube, with a small ball in the middle and a stop-cock at each end. The cannulæ having been inserted are allowed to fill with blood so as to expel the air; or that in the patient's vein, if no blood will flow into it, is filled with warm water. The india-rubber tube having been previously filled with warm water, is now applied to the cannulæ, and the stop-cocks turned on. The small ball is then squeezed, while the tube is pinched on the side of the donor by an assistant. This drives the fluid in the tube into the vein of the patient.

The tube is next pinched on the side of the patient, and the ball allowed to expand and then emptied as before. Each squeeze of the ball drives in three drachms of blood. Immediate transfusion from artery to vein has only been performed when an animal has been the donor. In this operation the carotid artery of a lamb or calf is connected directly with the vein of the patient by means of a simple india-rubber tube, with a cannula at each end. The force of the animal's circulation is quite sufficient to carry the blood into the patient's vein. As the result, however, of a series of experiments carried out at the request of the Obstetrical Society of London, Professor Schäfer has recommended immediate transfusion from artery to artery as the most efficacious method of performing the operation (*Trans. Obst. Soc. Lond.* 1879, vol. xxi.). The quantity injected in any of the foregoing methods of operating varies with the effect produced. Sometimes as much as a pint has been introduced. Half that quantity is usually sufficient to produce a marked effect.

MARCUS BECK.

**TRANSFUSION OF MILK.**—This operation, or, as it is more correctly termed, *Infusion or Intravenous Injection of Milk*, has been recommended in America by Thomas (*N. Y. Med. Journ.* May, 1878), Howe (*N. Y. Med. Rec.* 1878, p. 443), and others, as a substitute for transfusion of blood. In this country it has been practised and recommended chiefly by Dr. Austin Meldon, of Dublin (*Med. Press and Circular*, Oct. 22, 1879; and *Lancet*, 1880, vol. i. p. 527). The subject has been experimentally studied in France by Béchamp and Baltus, Laborde, Culcer, and others, with the result of showing that a small amount of milk may be injected without any evil consequences; but if the quantity be too large and too rapidly injected, the animal dies asphyxiated after severe dyspnœa. The *post-mortem* examinations showed minute hæmorrhages and embolisms, caused by the milk-globules sticking in the capillaries of the lungs, kidneys, brain, and other viscera. The numerous cases in which the operation has been performed on the human subject show that it can be safely undertaken, provided that, in addition to the usual precautions observed in intravenous injections, the following points are attended to. The milk must be freshly drawn from a cow or goat. A goat may be brought to the bedside of the patient. The milk must be alkaline; and this is best secured by the addition of a small quantity of carbonate of ammonia. It must be raised to a temperature somewhere near that of the body. Under no circumstances must more than 4½ ounces be injected (Meldon). If any dyspnœa is observed the operation must be at once arrested. The injection is usually followed by a considerable rise of temperature, and there may be some disturbance of respiration, which passes off in a short time. The operation is reported to have been successfully performed in cases of cholera, pernicious anæmia, phthisis, and loss of blood; and it may perhaps be recommended as a last resource in some of these conditions if no blood can be obtained for transfusion. Injection of milk can only effect two of the purposes of transfusion. It can increase the amount of circulating fluid; and it can, in an imperfect way, supply food at a time when it could not otherwise be taken; but it can do nothing to increase the oxygen-carrying power of the blood. Its inferiority to immediate transfusion is self-evident; and it is more dangerous and less efficacious than the transfusion of freshly-defibrinated blood, either of man or animals.

MARCUS BECK.



**TRANSPOSITION OF VISCERA.** *See* ORGANS, Displacement of.

**TRAUMATIC** (*τραῦμα*, a *wound*).—That which is associated or connected with a wound or injury, for example, *traumatic fever*, *traumatic gangrene*, and *traumatic aneurism*.

**TREATMENT.** *See* DISEASE, Treatment of; and THERAPEUTICS.

**TREMENS, DELIRIUM.** *See* DELIRIUM TREMENS; and ALCOHOLISM.

**TREMOR** (Lat. trembling).—The most delicate form of clonic spasm, consisting of successive movements of very small amplitude. Tremors are seen principally in the hands, the head, the tongue, or the facial muscles, as a result of disease or of old age. They are commonly spoken of as 'coarse' or 'fine,' according to the amount of movement which they involve. For some account of the mode in which tremors are related to other disorders of movement *see* MOTILITY, Disorders of.

**TRICHIASIS** (*θρίξ*, the hair).—A morbid condition in which the eyelashes are inverted towards the eye. *See* EYE AND ITS APPENDAGES, Diseases of.

**TRICHINA** (*τρίχινος*, made of hair).—SYNON.: Fr. *Trichine*; Ger. *Trichina*.—A genus of nematoid worms, originally established by Professor Owen for the reception of the minute spiral flesh-worm (*T. spiralis*). This entozoon was first discovered in human muscle by Sir James Paget, when a student at St. Bartholomew's Hospital. The history of this and other discoveries in connection with trichina, so much misunderstood abroad, is exhaustively discussed in the writer's work on *Entozoa* (Supplement, 1869, p. 1 *et seq.*); but it must, in justice to continental observers, be here at least permitted us to remark that whilst Herbst was the first to rear capsuled *trichinæ* by experiment, and whilst Virchow was the first to rear and recognise sexually mature intestinal trichinæ in a dog, it yet remained for Zenker to open up a new epoch in the record of trichinal discovery, by a complete diagnosis of the terrible disease which these parasites are capable of producing in the human frame. With Leuckart rests the honour of communicating the fullest and most complete details in reference to the structure of the worm, whilst at the same time he solved most of the difficult problems relating to the source and genetic relations of the parasite. In this connection the separate labours of Pagenstecher, Davaine, and Heller are also especially noteworthy; the writer's own experimental results at the same time

corresponding very closely with those obtained abroad (*Linn. Soc. Proceed.*, 1865).

Description.—The *Trichina spiralis* may be described as a minute helminth, the sexually mature male measuring the $\frac{1}{18}$ of an inch, and the female $\frac{1}{8}$ of an inch in length. The tail of the male is distinguished by the presence of a bilobed prominence, between the divisions of which the anal opening is placed, and from which latter a single spiculum can be protruded. The female is stouter, and supplied with a bluntly rounded caudal extremity, the reproductive outlet being situated towards the anterior part of the body. The eggs measure only the $\frac{1}{1270}$ of an inch in their long diameter, their contained embryos being produced viviparously. As explained by Professor Leuckart, the entire course of development from the period of impregnation up to the time of sexual maturity may, under favourable circumstances, occupy considerably less than three weeks. The ingestion of trichinous pork is followed by the maturation of the muscle-larvæ in two days, by the birth of embryos in six days, and by the arrival of the migrating progeny within the muscles of the human or animal bearer in fourteen days. The formation of the lemon-shaped protective capsules around the muscle-worms is a subsequent process, requiring several weeks for its accomplishment. In the perfectly formed larvæ males and females are already recognisable as such.

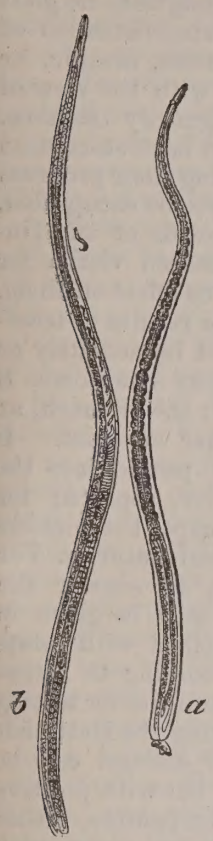


Fig. 97.
*Trichina spiralis* magnified; male (*a*), and female (*b*). After Leuckart.

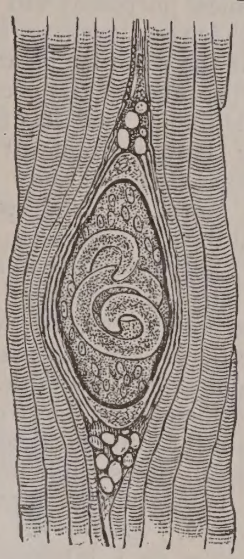

Fig. 98.
Portion of human muscle, enclosing a single capsuled *Trichina*. Highly magnified. After Leuckart.

The disorder produced by trichinæ is almost entirely due to the injury inflicted on the host by the act of wandering performed by the embryos. The grave symptoms and results thus superinduced are described in the article Trichinosis.

T. S. Cobbold.

**TRICHINOSIS or TRICHINIASIS.**—Synon.: Fr. *Trichinose*; Ger. *Trichinenkrankheit*.

Definition.—The name applied to the verminous disorder called 'flesh-worm disease,' or to that form of helminthiasis which results from the wanderings performed by the larvæ of *Trichina spiralis*. The discovery of this disease in the living human subject is due to Zenker. *See* Trichina.

History.—Whilst the literature of this affection is of great extent, the exigencies of clinical instruction can be sufficiently met by a brief record of the principal phenonema of the disease as ordinarily presented by trichinised patients. Whilst the discovery of the worm itself, as a nematoid, rests with Sir James Paget, the earliest recognition of the calcified and lemon-shaped capsules ('gritty particles') was made by Mr. Hilton of Guy's Hospital. Not only so; Mr. Hilton suggested the parasitic nature of the 'specks' observed in human muscle, which were, however, regarded by him as 'depending upon the formation of very small cysticerci.' The advocates of the prior claims of Tiedemann in this connection, though, in the estimation of a few persons, apparently well-established, do not pretend to credit that anatomist with the possession of the faintest conception of the parasitic origin of the specks, or 'stony concretions,' as he termed them in Froriep's *Notizen* for 1822. In 1828, Mr. Peacock observed similar little bodies. In looking at the subject from a pathological standpoint, we see how large a share our countrymen had in first recognising the trichina capsules in their calcified state. This degenerated condition may be regarded as an invariable sequela of the disease, whenever the latter has run its natural course without proving fatal to the bearer. Mr. Richard Davy discovered a number of lenticular or oval bodies, averaging the fourth of an inch in length, in the muscles of a dissecting-room subject at the Westminster Hospital. To the naked eye they resembled the early condition of degenerating cysticerci; being also firm in texture, white, and of almost uniform size. The writer examined one on the 1st of March, 1876. It consisted of a dense fibrous capsule, containing caseous matter which effervesced on the application of strong acid. Probably they would have become concretions, similar to those described by Tiedemann.

Symptoms.—The symptoms of trichinosis, though by no means uniform, are tolerably characteristic. Under ordinary circumstances, the ingestion of badly trichinised meat, insufficiently cooked, is followed after a few hours by symptoms of indigestion, such as nausea and vertigo, which may be succeeded by actual sickness and marked febrile disturbance. In milder cases the premonitory indications are usually insufficient to excite attention; failure of the appetite, or aversion to food, with more or less *malaise*, being all that is noticeable. If only a very small quantity of diseased meat has been taken, the attack may pass off without particular observation; but in bad cases diarrhœa sets in, and may continue for several days in succession, the fever becoming more and more marked. The patient is now prostrate. The extremities become stiff and painful; and thus the first stage of the disorder, usually lasting for about a week, is completed. The second stage of the affection is coincident with, and dependent upon, the active migration

of the progeny resulting from the maturation and propagation of the capsuled trichinæ originally ingested by the patient. The fever increases; there is œdema of the face, which, however, in some cases is limited to the eyelids. Movements of the eyes are accompanied with pain, and there is intolerance of light. Later on, the muscles of the limbs are swollen and rendered extremely painful to the touch, the slightest attempt at movement causing excruciating distress. The tongue is red and slightly coated. The pulse is very rapid, rising to 110, 120, or more, per minute; the respiratory movements and temperature likewise generally increase in rapidity and height. There is usually abundant perspiration, whilst the thirst is by no means excessive. In all cases the pain is apt to render the patient very irritable, his inability to sleep being one of the most distressing symptoms. In grave cases delirium frequently sets in; the limbs become flexed and paralysed; and there is also, generally speaking, excessive and continuous diarrhœa, which rapidly exhausts the patient, and places him in great danger. He lies on his back in a state of utter helplessness, and frequently can neither move a limb, sneeze, yawn, nor perform the ordinary acts of mastication and swallowing, in consequence of the paralysis of the various muscles concerned in these different functions.

Course and Terminations.—In about a month or five weeks from the commencement of the attack the second stage of the disorder is completed; but the lines of demarcation between these various stages of the malady are necessarily somewhat arbitrary. If death take place, it usually happens before the completion of the second stage, in the third or fourth week; but when the patient's strength can support the complete immigration of all the progeny resulting from the original infection, then the marked cessation of the febrile symptoms indicates the commencement of the third stage or common period of recovery. This third stage, however, is not one of invariable convalescence. As a rule, the diminished frequency of the pulse, the improved state of the respiration, and the diminution of the temperature go on more or less uniformly, until the patient's strength gradually returns with his recommencing and, at first, very slowly increasing appetite. In bad cases, however, the diarrhœa continues, and there is a general collapse of all the vital powers, resulting from all sorts of sequelæ that had set in during the progress of the affection. Amongst these, affections of the chest usually play a conspicuous part, such as hæmoptysis, pneumonia, and hydrothorax. During the period of returning convalescence, the appetite sometimes becomes voracious, the body rapidly gains flesh, and there is always more or less desquamation of the cuticle. The periods both of recovery and death, as the case may be, are exceedingly variable; in some instances the health not being re-established until two or even three months have elapsed.

Diagnosis.—The diagnosis of this disease must be founded on a consideration of the symptoms described, taken in connexion with the discovery of the parasite itself, first, in the suspected articles of food; secondly, as adult trichinæ, in the alvine evacuations during the first six or eight weeks of the disease; and, thirdly, as specimens obtained from the muscles of the living subject by an instrument called the harpoon, or by simple incision, the part being anæsthetised.

Treatment.—The indications as to treatment are obviously few and simple. To support the strength is essential. In our judgment no good can possibly result from the administration of the picronitrate of potash, benzoin, arsenic, or any other drug which is given with the view of destroying the young and migratory trichinæ. When once the young parasites have started on their journey, all hope of arresting their progress is at an end; when they have become encapsuled, even a strong solution of chloride of zinc (injected into the body of the deceased victim for anatomical purposes) will have no effect on them. Far otherwise, however, are the results of treatment if the disorder be attacked immediately on the appearance of the premonitory symptoms. If the trichinous food has not left the stomach, an emetic may prevent all further mischief. If the stomachal contents have passed into the upper bowel, a brisk purgative, repeated for several days in succession, may expel the trichinæ before they have arrived at sexual maturity. For this purpose, nothing seems to answer the end so well as calomel, which may be given in five-grain or larger doses, combined with jalap, scammony, or colocynth. According to Rupprecht (who enjoyed large opportunities for testing the value of different drugs during the Hettstädt outbreak), one-scruple doses of calomel can be borne, not only with impunity, but with positive advantage. Castor oil and turpentine, either separately or combined, may be given with benefit; but the employment of the ordinary vermifuges, such as male fern and santonin, is clearly contra-indicated. A good, active cathartic, such as the compound senna mixture, or the simple scammony draught of the British Pharmacopœia, will probably be fully as efficient as any of the drugs usually administered as vermifuges. The measure of success is clearly dependent in the main upon prompt catharsis. In cases where the second stage of the disorder has fairly set in, less active purgatives may be given at first, the great object being to lessen the fever, and to support the system by judicious dieting. The disinclination of the patient to take food of any kind must be overcome at all hazards, and soda-water, with meat extract very slightly diluted, must be administered. When the yolk of an egg, or milk, or broth can be given in the ordinary way, as a meal, it should be preferred. As remarked before, the strength must be supported, if necessary, by small quantities of wine or brandy. In this way the patient's life may be upheld during the most critical period, after which, when convalescence is being re-established, the employment of the ordinary vegetable tonics and steel may be advantageously resorted to. Natural chalybeate waters are also likely to prove serviceable.

Prevention.—In regard to the prevention of trichinosis, all that need be remarked in this place has reference to the temperature to which all cooked meat should be raised in order to kill the parasites. According to most authorities, trichinæ succumb to a moist heat of 170° Fahr.,

whilst some assert that 20 degrees less than this, if prolonged, is sufficient for the purpose. According to some interesting experiments by Dr. Lewis, the centre of a leg of mutton attains a temperature of 107° Fahr. in about five minutes after the surface of the joint has been exposed to boiling heat (212°). Clearly, with the most ordinary precautions it is easy to avoid infection. Recent experiments show that salting is not fatal to the capsuled trichina. England is singularly free from trichinosis; but rather from the circumstance that our swine rarely contain trichinæ, than that we are unaccustomed to eat underdone meat. Only one small outbreak of trichiniasis has been observed within our borders, the original account of which, by Dr. W. Lindow Dickenson, appeared in the *British Medical Journal* for the year 1871. Some outbreaks supposed to be those of true trichinosis have turned out to be spurious. The epidemic on board H.M. training ship 'Cornwall' was of this character. An autopsy of one of the boys revealed the existence of a new species of free nematoid, which the writer called *Rhabditis Cornwalli*, and which Dr. Bastian named afterwards *Pelodera setigera*. A large number of parasites have been wrongly described as trichinæ, thus causing much error of interpretation (*see* PELODERA). In Germany true trichina epidemics have been notoriously frequent, and thus for our knowledge of the phenomena of the disorder we have been mainly dependent upon the writings of Rupprecht, Zenker, Virchow, Leuckart, Pagenstecker, Heller, and others. The disease is not infrequent in the United States, where, however, it is for the most part confined to the German inhabitants, who have retained the habit of eating 'smoked sausages,' so common in the Fatherland. (For details, see Dr. Sutton's excellent *Report on Trichinosis*, as observed in Dearborn co., Indiana, in 1874: *Transactions of the Indiana State Medical Society* for 1875; and also, especially, Dr. W. C. W. Glazier's *Report on Trichinæ and Trichinosis*, published by order of Congress, Washington, 1881.) For further particulars on this subject the reader is referred to the writer's book on *Parasites*; to Dr. Althaus's *Essay on Trichinosis*; and to the still more elaborate and exhaustive memoir by Dr. Thudichum, published in the reports of the Privy Council for the year 1864. *See* TRICHINA.

T. S. COBBOLD.

**TRICHOCEPHALUS** (θρὶξ, a hair, and κεφαλὴ, a head).—SYNON.: Fr. *Trichocéphale*; Ger. *Haarkopfwurm*.—A genus of nematode worms, comprising forms in which the anterior two-thirds of the body is filiform, terminating in a mere point. They are sometimes called whipworms; the thickened body answering to the handle of the whip. The human species (*T. dispar*) varies from an inch and a half to two inches in length, according to sex, and it resides principally in the cæcum. The male is smaller than the female, and is readily recognised by its spirally contorted tail. This parasite probably enjoys a wide distribution; but little attention has been paid to it out of Europe. In England it is rare as compared with France, where, according to the testimony of Davaine and Duval, it is extremely abundant, the former authority having calculated that one-half of the Parisians were infested by it. Leidy says it is frequent in the United States. Clinically, its importance by no means corresponds with its prevalence; nevertheless, in rare instances it has been known to occasion severe symptoms. A most interesting case of this kind has been placed on record by Mr. D. Gibson, in which 'paralysis, with loss of speech' resulted from the intestinal irritation occasioned by the presence of large numbers (*Lancet*, August 9, 1862, p. 139). In like manner, Davaine quotes a case by M. Felix-

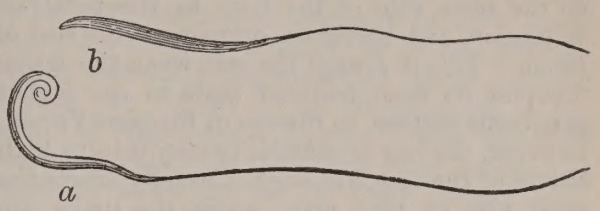


FIG. 99. *Trichocephalus*; male (*a*), and female (*b*). Enlarged one-fourth.

Pascal, where a little girl, four years of age, died with cerebral symptoms, the *post-mortem* revealing the presence of a 'prodigious quantity' of whipworms in the cæcum and colon. The writer has occasionally expelled this parasite when employing vermifuges for other parasites. It is worthy of remark that in animals the presence of a closely allied species (*T. affinis*) has been known to produce severe intestinal irritation. *See* WHIP-WORM.

T. S. COBBOLD.

**TRICHOMONAS VAGINALIS** (θρὶξ, a hair, and μονὰς, a monad; and *vaginalis*, connected with the vagina).—A ciliated infusorial animalcule, discovered by Donné in the vaginal mucus, and somewhat resembling a spermatozoon. *See* RAPE.

**TRICHOPHYTON** (θρὶξ, a hair, and φυτὸν, a plant).—A genus of parasitic fungi, to the presence of which tinea is due. *See* TINEA.

**TRICUSPID VALVES and ORIFICE, Diseases of.** *See* HEART, Valves of, Diseases of.

**TRIFACIAL NERVE, Diseases of.**—The fifth or trifacial nerve (*nervus trigeminus*), the largest of the cranial nerves, consists of a motor and sensory portion, the sensory fibres passing through the Gasserian ganglion and being distributed to the face and a portion of the head. The motor portion, much the smaller, is physiologically independent of the ganglion, and supplies the pterygoid, masseter, buccinator, and temporal muscles. The two first divisions—the ophthalmic and superior maxillary—are entirely sensory, and proceed from the ganglion. The third, or inferior maxillary division, proceeds also from the ganglion, but receives besides the whole of the motor root. Lesions of this nerve cause disorders of sensation, motion, nutrition, or secretion according to the anatomical position and extent of the injury.

The affections of the fifth nerve may be considered in the following order:—

1. **Trifacial Neuralgia.**—Neuralgia may affect one or all of the three divisions of the nerve.

It is fully described under the head of tic-douloureux. *See* TIC DOULOUREUX.

2. **Trifacial Anæsthesia.**—Anæsthesia of the trigeminus, usually unilateral, may be dependent either upon (*a*) *central lesion*; or upon (*b*) *peripheral lesion.*

(*a*) *Central lesion.*—Hemiplegia from apoplexy, tumour, or other coarse disease of the central nervous organs is usually accompanied by some anæsthesia in the district supplied by the trigeminus, arising from interference with the integrity of the fibres of origin of the nerve in their central course. The anæsthesia usually occurs on the same side of the body as the paralysis of motion, and therefore opposite to the seat of lesion. This is always the case when the lesion occupies its most frequent seats in the higher ganglionic centres. In disease of the pons Varolii, however, the loss of sensibility may involve both halves of the face, although it usually affects the same side as that upon which the limbs are paralysed, and opposite that upon which the portio dura and sixth nerves (when either or both of them are involved) are affected. In cases of apoplexy, the anæsthesia is usually very imperfect, and not sharply defined. It is short-lived, lasting from a few hours to days; but in certain cases it may continue, and even outlive the motor paralysis with which it is conjoined.

Intracranial tumours may produce more persistent anæsthesia, either by immediate destruction of sensory fibres, or, indirectly, by the cerebral enlargement, due to their growth, causing compression of the fifth nerve as it traverses the floor of the skull.

(*b*) *Peripheral lesion.*—Anæsthesia dependent upon lesion of the trigeminus in its peripheral course is a symptom of serious moment, which it is important to distinguish from that of central origin, and this may be accomplished by noting the following points:—The degree of peripheral anæsthesia far exceeds that which obtains in cases owing their origin to a central cause. It is much more complete, and involves, which the latter does not, trophic and vaso-motor complications. Its extent varies according as the trunk of the nerve, including the Gasserian ganglion, is involved; or only one or two of its branches. Should the main trunk be affected, there is more or less complete anæsthesia of one side of the face and part of the ear, conjunctiva, cornea, nostril, mouth, half the tongue, the gums on the same side, and a part of the palate. If the conjunctiva be touched with the finger, there is no reflex contraction of the eyelids. A glass from which the patient drinks seems to him as though it were broken, for he feels the material on the sound side and not on the affected side. The skin of the face is cool, and may be somewhat œdematous, and purplish in tint. After a few days, if the cause persists, the eye on that side looks dry, glazed, and congested; the cornea becomes cloudy, and in time sloughs and perforates, the contents of the eyeball escaping to a varying extent, so that the organ is destroyed. There is dryness of the nostril on the affected side, and irritant substances applied to it fail to produce sneezing. Taste is lost on that side of the tongue, except at the base, which is supplied by the glosso-pharyngeal nerve. The salivary secretion is diminished. In time there may be bleeding from the gums, and ulceration of the mucous membrane. Should the lesion exist upon one of the three divisions of the trigeminus, the anæsthesia will be found sharply limited to the district supplied by that division. The nature of the lesion must be determined by the examination of concomitant conditions. Whatever be the active cause by which the nerve is damaged, the effects will be the same; pressure upon, and disorganisation of the nerve-fibres will result in the disorders described—sensory, motor, trophic, and vaso-motor. In such circumstances, one or more of the other cranial nerves are usually affected coincidently. In tubercular meningitis, the fifth nerve is shown to be paralysed (along with others traversing the floor of the skull) by the conjunctivitis and corneitis so often present in advanced stages of the disease. Should the condition accompany bulbar paralysis, the lesion must be referred to the nuclei of origin of the nerve in the medulla oblongata.

TREATMENT.—Syphilitic gummata on the floor of the skull, developed either in the membranes of the brain or in the nerve itself, are so frequently the cause of the disorganisation of the fifth nerve which gives rise to anæsthesia, that in all cases it is right—unless some other cause is evident beyond all doubt—to bear in mind the possibility of such a cause, and to prescribe accordingly without delay. Ten-grain doses of iodide of potassium should be administered every four hours. Should there be a gumma pressing upon the trunk of the nerve, this treatment will have the effect of bringing about a rapid amelioration, and, in many cases, supposing it has been applied early enough, a complete cure. It is evident that, as regards other causes, there is no particular indication for treatment, which must be adapted to the special circumstances of the case.

3. **Trifacial Hyperalgesia.**—Hyperalgesia may accompany or precede neuralgia of the fifth nerve. It may also precede facial anæsthesia when this is due to neuritis. There are varieties in the degree of this hyperalgesia. It is sometimes so severe that the slightest touch occasions pain. The face cannot then be washed in the ordinary way, but the patient has to take a piece of sponge or wetted rag and cautiously dab the skin with it. Sometimes it is described as a feeling of soreness only when the hand is passed over the face. In either case the condition is accompanied by diminution of the tactile discrimination in the part. In *mimetic spasm* of the portio dura, there is often hyperalgesia in the region of one or more divisions of the fifth, and the lesion is then doubtless connected with the deep origin of the nerve. In blepharospasm it will often be found, if the face be carefully examined, that pressure with the finger at some point will check the spasm.

Subcutaneous division of a twig of the fifth (or afferent nerve) at this point, will often bring about a cure of the affection. The supra-orbital or subcutaneous malar, are the nerves most commonly in fault.

Photophobia is referable to hyperalgesia of the branches distributed to the conjunctiva.

**4. Motor Disorders.**—Affections of the motor root of the fifth nerve are either (*a*) of a *spasmodic*; or (*b*) of a *paralytic* character.

(*a*) *Spasm.*—Spasm of the muscles supplied by the trigeminal nerve may be tonic or clonic. In trismus, or 'locked jaw,' the teeth are clenched together by the tonic contraction of the masticatory muscles, which can be felt tense to the touch. According as the muscles are generally involved, or only partially, the lower jaw will be fixed in a symmetrical position, or be pulled over to one side, or advanced or receded. Clonic spasm of the same muscles is observed in various convulsive disorders; and slower movements of a horizontal character constitute the grinding of teeth sometimes indicative of cerebral disease.

Trismus may either be one symptom of tetanus, or it may occur by itself, and then it either arises from cold, or is of reflex origin, from irritation of the sensory portion of the nerve by decayed teeth, dentition, or disease of the jaw-bone. It may be due to the presence of a foreign body, possibly of very small size, lodged in the cicatrix of a wound upon the face, or even in some distant part of the body. Irritation from worms is a possible cause. It is still more commonly hysterical.

Treatment.—When arising from cold, the constant current should be applied to the contracted muscles. Any source of irritation must be sought for, and, if possible, removed or remedied.

The removal of a foreign body will sometimes bring about an immediate cure. This failing, the hypodermic injection of morphia, in doses of gr. $\frac{1}{6}$, may be employed, and bromide of potassium given internally in doses of 20 grains. When the presence of worms is suspected, appropriate treatment must be employed. If the affection be hysterical, somewhat powerful faradaic currents, directed to the muscles of the jaw, will scarcely ever fail to open the mouth and cure the ailment. Hysterical trismus will not be mistaken for dislocation of the jaw, if it be remembered that in the latter accident the jaw is fixed with the mouth partly open.

(*b*) *Paralysis.*—Paralysis of the masticatory muscles is not very common, but may be observed sometimes in cases of bulbar paralysis, or it may accompany anæsthesia of the face, and depend upon tumour, abscess, aneurism, or some such coarse disease encroaching upon the trunk of the nerve within the cranium. To test the state of the muscles, the patient should be asked to move his jaw to and fro laterally, as well as in opening and shutting the mouth. Any irregularity of movement will be evident to the eye, and defective strength or absence of contraction in the affected muscles may be felt by placing a hand on each cheek, whilst the patient performs movements of mastication. When the jaw is found to fail in being carried to one side in a munching movement, the fault of course lies with the pterygoid muscles of the *opposite* side. The affection is more often unilateral than bilateral. Its importance is bound up with that of the lesion which gives rise to it.

As in peripheral affections of the sensory portion of the nerve, especial attention should be paid to the causation, and if this probably depends upon a tumour, the possibility of its syphilitic character should be borne in mind, and iodide of potassium administered.

T. Buzzard.

**TRISMUS** (*τρίζω*, I gnash.)—Lock-jaw, or tetanic closure of the jaws; a prominent symptom in tetanus. *See* Tetanus.

**TRISMUS NASCENTIUM** (Lat.).—A form of tetanus occurring in newly-born children. *See* Tetanus.

**TROPHIC LESIONS.**—Description.—This name is given to various departures from healthy nutrition, which are caused (*a*) by the cutting off, from certain tissues or parts, of some customary nervous influence, as in the production of 'secondary degenerations' in the nervous system (*see* Spinal Cord, Diseases of, § 6), or in the production of rapid muscular atrophy, consequent upon the severance of or severe damage to motor nerves or their related ganglion-cells in the anterior cornua of the cord; and also to lesions or morbid changes which are caused (*b*) by some irritative or perverted influences passing outwards along nerves to certain tissues or parts, so as to weaken or otherwise disturb their nutrition. In this latter way, the nutrition of the skin and its appendages may be variously affected, leading to eruptions of different kinds, to atrophy, to ulceration, or undue proneness to inflammation, as well as to altered pigmentation of the skin or blanching of the hair. Or the nutrition of the joints may be affected, as in some forms of hemiplegia, and of locomotor ataxy more especially. In these various cases there may be disease, secondary or primary, of the grey matter of the spinal cord, or some irritative lesions of the sensory nerve-roots or trunks.

Pathology.—Much dispute has taken place during recent years as to the modes in which such nutritive changes are brought about. Some have endeavoured to establish the existence of special 'trophic nerves,' and have taught that the various trophic lesions referred to above, are to be explained by a cutting off or a perversion of the influences usually operating upon the tissues through such nerves. Others believe that these nutritive changes can be accounted for by altered states of excitation of the vaso-motor nerves, leading to spasms or dilatations of the vessels supplying the parts affected, and, as consequences, to the nutritive changes themselves (*see* Sympathetic System, Disorders of). Much evidence, however, could be cited against both these modes of explanation, and it seems, on the whole, more probable that trophic lesions are due either (*a*) to the cutting off of certain accustomed influences (*viâ* motor channels), or (*b*) to the action upon the tissues of perverted or unnatural influences (in a peripheral direction *viâ* sensory channels).

On the subject of these trophic lesions *see* also Spinal Cord, Diseases of, § 7; Glossy Skin, and Unilateral Facial Atrophy.

H. Charlton Bastian.

**TROPICAL DISEASES.**—Diseases incident to hot climates. *See* Climate; Disease, Causes of; and the special diseases, such as

Cholera; Chyluria; Dysentery; Fungus Foot of India; Intermittent Fever; Liver, Diseases of; Remittent Fever; and Sunstroke.

TUBERCLE (*tuberculum*, a little swelling). Synon.: Fr. *Tubercule*; Ger. *Tuberkel*.—We have not yet attained to anything like unity of opinion in respect of tubercle. We are not yet agreed concerning what shall take the name of tubercle, and this alone implies the utmost discord in other matters. It is a chapter of pathology wherein few assertions can be made which will stand the test of a dogma; that is to say, a belief held always, everywhere, by all. But although dogma has no place here, it would be wrong to fly to the other extreme of denial. A method of simple inquiry will be our safest guide through so perplexed a topic. We will note the diverse opinions in order as they arose, being convinced that most of these opinions are true in some particular, that they commonly err by exclusiveness, and that the next best thing to the absolute truth will be found in a comprehension of all opinions.

There have been four stages in the history of tubercle, namely, the first, or etymological stage; the second, or stage of morbid anatomy studied by the naked eye; the third, or stage of morbid anatomy studied by the help of the microscope; and the fourth, or stage of experimental pathology.

*Stage I.*—This stage begins with the earliest writings on medicine. The word tubercle has not yet been wrested from its original meaning: tuberculum, a little lump of any kind. And this primitive etymological meaning survives even in the present day. We still speak of tubercles of the ribs and other bones; acne is a tubercular disease of the skin, and so on. But down to the beginning of the nineteenth century, tubercle meant a little lump, and nothing else.

*Stage II.*—At the beginning of the present century tubercle lost its simple etymological meaning, and acquired a pathological meaning. Tubercle is no longer a matter of special shape, for now it signifies a special structure. This great change concurred with the rise of morbid anatomy. And thus it came to pass. Many of the dead bodies examined were necessarily cases of pulmonary consumption, and in this form of disease it was that little morbid lumps or tubercles were discovered with especial frequency. Hence the tubercles found in phthisical lungs early showed a strong tendency to become emphatically the tubercles of pathology. We may remark this tendency in Morton (A.D. 1689), and in Baillie (1795). But it was Bayle (1803) who first broke with the ancient meaning altogether, and introduced the second stage of opinion. Debates concerning tubercles are henceforth debates concerning morbid structures.

Bayle thus defines tubercle: A homogeneous substance; always opaque; in colour, white or dirty white, sometimes yellowish, sometimes greyish; in size, from a millet seed to a chestnut. He makes the criterion of tubercle to consist in its opacity. Now this opacity is most marked in the cheesy products of degeneration. Therefore, in other words, the criterion of tubercle consists in the cheesy state. Cheesy matter, wherever found, in the shape of a little lump or not, is the tubercle of Bayle. He called that tubercle which Baillie had called scrofulous matter.



Bayle did not, and could not, overlook the fact that the lungs sometimes contain little nodules which are translucent. He would not call them tubercles because they lacked his note of tubercle, opacity; he called them granulations. Granulations are never opaque. And so, between tubercles and granulations he drew an excessively strong distinction.

It was not long before Laennec (1819) reunited what Bayle had put asunder, by showing that granulations at length became opaque. And, therefore, he enlarged the definition of tubercle, so as to make it include, not only actual, but also potential cheesy matter. Thus Laennec's tubercle acquired a most inclusive pathological meaning. Moreover, he remarked that tubercle sometimes involves large, irregular tracts of tissue, a condition which he distinguished by the name of tuberculous infiltration. Each of these forms, the nodular and the infiltrated, he subdivided into three—the transparent, the semi-transparent, and the opaque or cheesy. Hence six forms of tubercle in all—three nodular, namely, the transparent, or Bayle's granulations, the semi-transparent or miliary, and the opaque or crude yellow tubercle; three diffused, namely, the transparent or gelatiniform infiltration, the grey or semi-transparent infiltration, and the yellow or opaque. Laennec's descriptions relate especially to the lungs of adults. But the structure of the lungs makes the study of tubercle singularly difficult in them, and it is easy to note that our debates concerning tubercle in general show an unconscious leaning towards pulmonary tubercle in particular. The writer does not say that this is wrong; we feel that if we could master tubercle in the lungs the rest would soon follow.

Laennec's unit began to be broken up when men set themselves to discover the seat of tubercle. Carswell (1838) proved, what Broussais had guessed, that crude tubercle was often formed within the cavity of the pulmonary air-sacs. Thomas Addison (1845) went much further. He began by examining genuine pneumonia, which he found to have its original and essential seat in the air-cells of the lungs, and the ordinary pneumonic deposits are poured into these cells. And when he, like Carswell, found this to be the chief seat of Laennec's crude yellow tubercle and grey and yellow tubercular infiltrations, he declared that, if called upon to give an expressive name to these lesions, he would venture to designate them scrofulous pneumonia. The case was altered with respect to the granulations; these he found to be seated in the delicate filamentous tissue which forms the slight filmy parietes of the air-cells. Let it be understood that Addison's criterion of tubercle lay in its formation in the septa of the air-sacs; he denied the criterion to be cheesiness, and thus, in matter of fact, his use of the word tubercle was almost the exact contradictory of Bayle's. Addison revived in some degree Baillie's scrofula. The other forms of Laennec's tubercle, Addison conceived to be inflammatory exudation, mingled or not with his own true tubercle. It seems as if the naked eye could not carry us much farther.

*Stage III.*—About this time the microscope began to be used for examining healthy and diseased tissues. Cheesy matter being commonly deemed the most characteristic form of tubercle, men naturally supposed that the microscopical characters of tubercle would be found in cheesy matter. Tubercle being thought, moreover, to possess perfectly distinct naked-eye characters, it was expected that its minute structure must likewise be peculiar and distinct. And thus it came to pass that Lebert (1844) found certain bodies in cheesy matter which he believed to be characteristic of tubercle, and which he called tubercle-corpuscles. These corpuscles, not being found in the transparent granulation, some persons went so far as to deny its tubercular nature, and so revived Bayle's doctrine, in all its severity, upon a microscopical platform. But William Addison (1849) came to a very different conclusion respecting the characters of pulmonary tubercle. He repeatedly examined with the microscope the material deposited in the air-cells of the lungs in pneumonia, and compared its characters and appearance with that forming a tubercle, without being able to detect any more essential or specific difference between them than exists between purulent matter recently excreted and that of an old chronic abscess. This was a microscopical confirmation of Thomas Addison's doctrines. Virchow (1850) arrived at the same opinion, namely, that there was nothing characteristic of tubercle in cheesy degeneration. For instance, nowhere is the cheesy degeneration better seen than in the enlarged glands of scrofula; yet, examine these glands before they become cheesy, and nothing more (so Virchow said) than a simple hyperplasia will be found, and no new formation. On the other hand, examine tubercle before it becomes cheesy, examine the transparent granulations, and it will be found to possess a distinct lymphatic character. But granulations are formed in the connective tissue; hence they are heteroplastic. So that Virchow's tubercle signifies a heteroplastic lymphoma. The characteristic tubercle is not opaque, but transparent; in this respect Virchow's doctrine was the exact opposite of that taught by the French school. The criterion of tubercle with him is not cheesiness but heteroplasia. Of late years both parts of Virchow's definition have been assailed: first, the connective tissues which are infested by tubercle have been shown to possess in many places a true lymphatic character, so that tubercle, if a lymphatic growth, may be simply hyperplastic as well as heteroplastic; next, the lymphatic character of tubercle has been put in question by the investigations of Langhans and others. Thus Virchow's distinction between tubercle and scrofula becomes untenable; but we will postpone further discussion of these matters for the present.

*Stage IV.*—The results of experiment upon living animals, or what is commonly called the inoculation of tubercle, will be narrated at the end of this article. Enough to say in this place that most important changes in the doctrines of both tubercle and scrofula have been largely due to the experimental pathology of the last fifteen years.

Here ends the preliminary historical sketch. Now we will inquire into the present state of opinion concerning the characters of tubercle.

**I. Concerning the structure of single tubercles.**—The formation of tubercle begins at distinct foci. The primitive tubercle is a microscopic body. W. Addison (1849) taught that it consists, in greater part, of corpuscles, like blood-leucocytes, or like the corpuscles of lymph and of pus. Rokitansky (1855) showed that giant or myeloid cells are sometimes found in tubercle. Virchow (1863) taught that tubercle has a more histioid or tissue-like structure, which, on the whole, resembles most the tissue of a lymphatic follicle; so that, in the case of the spleen, tubercle is not always easily distinguished from a Malpighian body. In a tubercle there are corpuscles imbedded in a reticulum. The corpuscles are round; and most of them are like lymphatic corpuscles, smaller than blood-leucocytes; some, however, are larger, it may be twice or thrice. The corpuscle is colourless, translucent, slightly granular, and easily broken up. In the fully developed cell there is a single nucleus, small, tolerably homogeneous, often shining. The larger cells contain two, three, or even as many as twelve nuclei. The reticulum consists of a fine network of connective-tissue fibres. When vessels are present in the tubercle, they are not new-formations, but only remnants of the tissue in which the tubercle has been formed. According as the cellular or the fibrous element of the tubercle predominates, it may be called cellular or fibrous tubercle, the former being more common. The fibrous element sometimes predominates so much that the tubercle can be distinguished from a small fibroma only by a concurrence of the more common cellular form, or by a tendency to undergo the further changes of tubercle, especially the cheesy change. In the fibrous tubercle there are often found large, roundish, epithelioid cells, with large oval or round, sharply-defined nuclei. From this description it will be seen that Virchow recognised lymphoid, epithelioid, and myeloid or giant-cells, among the elements of tubercle. Langhans (1868) was the first to lay much greater stress upon the giant-cells; he found them to be an

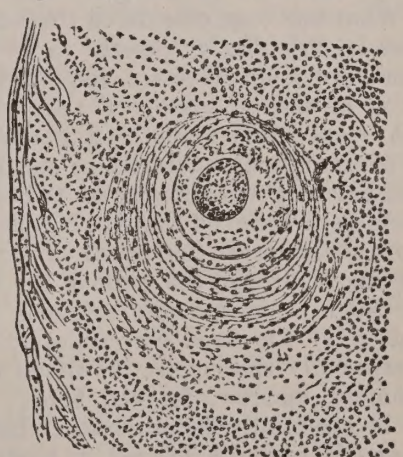

FIG. 100. A tubercle in a lymphatic gland: in the upper third, a large giant-cell (with peripheral nuclei); margin of normal follicular tissue round the tubercle; on the left, the capsule of the gland and cortical lymph-sinus. × 60. (*After Creighton.*)

almost constant element of tubercle in any part. He believed that the tubercular giant-cell had characters proper to itself, namely, a finely

granular protoplasma, and nuclei of equal size, peripheral, and arranged in radiate fashion. In cellular tubercle, the epithelioid cells are arranged around the giant-cell. In fibrous tubercle a giant-cell is always present at the very centre. Wagner (1871) described tubercle under the name of tubercular (*tuberkelähnlich*) lymphadenoma, the structure being the same as that of a lymphatic follicle (namely, lymphoid corpuscles, and many nuclei almost destitute of surrounding protoplasma, imbedded in a fibrous reticulum) and in the middle of each tubercle, a giant-cell. Schüppel (1871), who devoted himself chiefly to tubercle of the lymphatic glands, considered the gigantic cell to be an essential (though not peculiar) element of tubercle. A primitive tubercle consists of a central giant-corpuscle, that is to say, a mass of protoplasma of very varied form, spherical, flat, or elongated; the edges even, or provided with more or fewer processes; more or less granular; and containing a large number of nuclei, to be reckoned by the score, even as many as two or three hundred. Around this giant-cell lies a zone of epithelioid cells, which make up the greater part of the tubercle. They are very delicate, easily broken down, and the fact that tubercle has been supposed to consist chiefly of lymphoid corpuscles is due to the setting free of the epithelioid nuclei, which have been mistaken for leucocytes. Lastly, true lymphoid corpuscles are scattered through the tubercle, filling up the interstices between the other cells as it were. In fibrous tubercle there are no epithelioid cells, a fact which Schüppel believes to indicate an arrest in the growth of the tubercle at an early stage. Supporting all these cells, there is a reticulum like that of lymphadenoid tissue. These primitive tubercles contain neither blood-vessels nor lymphatics. Friedländer (1874), with especial reference to these giant-cells, very truly insists that they are by no means peculiar to tubercle; on the contrary, they are found in a number of other structures, both healthy and morbid. Moreover he maintains that there are no distinguishing characters in the giant-cells of tubercle. What has been considered the reticulum of a tubercle, Friedländer asserts to be the result of the hardening processes employed in the preparation of the microscopical specimen; in the fresh state there is nothing but a small quantity of amorphous intercellular matter.

II. **Concerning the origin of tubercle.**—William Addison believed that the lymphoid corpuscles of tubercle were the result of exudation from the blood, through the walls of the vessels. Virchow taught that tubercle proceeds from a proliferation of the fixed corpuscles of sundry tissues, especially the connective-tissue and its allies, namely, marrow, fat, and bone. Hence tubercle is essentially heteroplastic, that is to say, lymphatic tissue is formed in parts where it does not naturally exist. But is there, then, no such thing as tubercle of the lymphatic structures? This is a troublesome question for Virchow. However, he does not deny that tubercle may be found in lymphatic glands; he supposes that it is formed, not in the follicles themselves, but in the connective-tissue trabeculæ which support them; also, that sometimes an adventitious connective-tissue springs up in the gland in consequence of chronic inflammation, and that the tubercle grows in this new tissue. Yet Virchow was not without misgivings respecting his doctrine of the heterology of tubercle, because he saw the close relationship which exists between connective and lymphatic tissues. He pointed out (1856) the frequency with which tubercle is seated in the outer coat of the small blood-vessels, and especially those of the cerebral meninges. Now Robin (1855) and His (1865) showed that this outer coat, or adventitia, is a lymphatic tissue. Neumann (1868) showed that marrow is a lymphatic tissue. In this way, fresh difficulties arose with Virchow's heteroplastic doctrine. In fact, the opposite opinion gained ground, that tubercle is commonly hyper- or homœoplastic. Wilson Fox (1868) and Sanderson (1868) held that it is very often nothing but a hyperplasia or overgrowth of pre-existing lymphadenoid tissue. Lymphadenoid tissue has been found to be much more extensively present in the healthy body than Virchow thought; for instance, in the submucous tissue of the whole alimentary canal; in the conjunctiva; around the smaller bronchia; around capillary tufts beneath the epithelium of the pleura and peritoneum; around the smaller arteries in many parts, such as the pia mater, liver, spleen (constituting the Malpighian bodies), and choroid; besides the marrow, spoken of before. And all these are favourite seats of tubercle. So much for the lymphadenoid tissue as a seat of tubercle. Klebs (1868) maintained that tubercle of the serous membranes arises within the lymphatic vessels, by a multiplication of their epithelium. And Rindfleisch (1871) describes, under the name of lymphangitis tuberculosa, a kind of fibrous tubercle often present around phthisical cavities. Each tubercle consists of a dense fibrous capsule, within which lie concentric layers of spindle-shaped, anastomosing cells. The tubercles are, in fact, developed from lymphatic vessels, by a metamorphosis of the endothelium and outer tunic; the remnant of the lumen of the vessel may often be found in the middle of the tubercle. Last of all, a fibrous sclerosis of the whole takes place. Aufrecht (1869) supposed that tubercle was formed around the lymphatics, and was therefore a perilymphangitis. But Sanderson declares that Klebs and Aufrecht mistook veins for lymphatics, and that the perilymphangitis of the latter is a hyperplasia of the lymphatic sheath of blood-vessels. Wagner (1871) leaned to the belief that tubercle (his lymphadenoma) is always heteroplastic, even when it occurs in parts which naturally possess a certain quantity of lymphadenoid tissue. And Rindfleisch (1871) teaches that the lymphoid cells of tubercle do not come directly from the blood, but from proliferation of the fixed cells of connective-tissue; the endothelium of blood and lymphatic vessels, the epithelium of serous membranes, lungs and kidneys, and even the muscle-cells of the smaller bronchia and vessels, undergoing a tubercular metamorphosis. Schüppel (1872) reduces the question to the origin of what he deemed to be the most important part of tubercle, namely, the giant-cell. It arises, he thinks, within a blood-vessel. Masses of molecular matter, very tenacious and adherent,

grow up in small blood-vessels (capillaries or small veins), and become bigger and bigger, until the vessel is quite choked, or even distended at the spot. At first there are no nuclei in the protoplastic mass, but afterwards they begin to appear; and their number is proportionate to the age of the corpuscle. Where the nuclei come from is uncertain. The epithelioid cells next appear around the giant-cell, and are most likely derived from processes of the giant-cell. The lymphoid cells come from the cells of the tissue in which the tubercle is formed. The reticulum, in chief part, is a neoplasm; it grows with the multiplication of the cells, and is always connected with the gigantic corpuscle. So soon as the giant-cell becomes surrounded by other cells, the wall of the blood-vessel disappears. Other authorities differ from Schüppel with regard to the origin of the giant-cell: some supposing it to be formed from the endothelium, some from blood-leucocytes, and some from free protoplasm. And here the question rests at present.

**III. Concerning the growth of tubercles.** The primitive tubercle increases in size until it becomes visible to the naked eye. The enlargement is brought about by the formation of fresh tubercular foci around the original focus; so that when six or more of the primitive tubercles become agglomerated into one body, it becomes visible as a small nodule (tuberculum). Sometimes the agglomeration does not assume the nodular form, but is diffused and of irregular shape; this is called an infiltration. The difference between nodular and infiltrated tubercle is merely a naked-eye difference; whether the confluent tubercles retain the nodular shape or not, the primitive tubercle is always a tuberculum. 1. *Nodular tubercle* corresponds to most of Bayle's granulations, and Laennec's miliary tubercles, which were spoken of before. The epithet miliary is much older than Laennec, and has lost its original etymological meaning. Miliary tubercle may or may not be of the size of a millet-seed. Tubercle the size of millet-seed may or may not be miliary. All that is now meant by miliary tubercle is a small nodule, roundish, seldom larger than a hemp-seed, almost colourless or greyish, consistence almost equal to that of cartilage, and either quite transparent or opalescent. Lastly, miliary nodules may or may not be tubercular. Miliary tubercle must be distinguished from other small nodular neoplasms; minute disseminated carcinoma and sarcoma, lymphosarcoma, leukæmic nodules, small fibromata. The diagnosis depends upon the discovery of more definite lesions in the same body, and upon the microscopical structure. In the lungs, miliary semi-transparent nodules are sometimes wholly pneumonic in character. The peribronchitis of Virchow possesses, according to Wagner, a lymphadenoid structure, and may therefore be considered a tubercular lesion. 2. *Infiltrated tubercle*, when present in the lungs, corresponds with much of Laennec's gelatiniform and grey infiltration. The gelatiniform infiltration may often be seen surrounding nodular tubercles, in cases of acute pulmonary tuberculosis. In the liver, tubercular infiltration runs along the capsule of Glisson between the lobuli. In the cortex of the kidney, it appears as streaks between the bundles of tubuli, or as ill-defined roundish patches. Tubercle, not nodular, often may be seen alongside the small arteries in the cerebral meninges. Wagner describes a diffuse lymphadenoma (tubercle) of the pleura, which is indistinguishable by the naked eye from chronic pleurisy; and even the microscope shows all stages of transition between lymphadenoid and granulation tissue, in these cases. A similar diffuse lesion occurs in the mucous membranes.

**IV. Concerning the lesions which surround tubercle.**—First, there is the mechanical effect of pressure. Next, the lymphatics and juice-canals around are widened and filled with chylous stuff containing a few corpuscles. Tubercle is also commonly associated with surrounding hyperæmia, and with inflammatory exudations in the neighbourhood. These secondary lesions are well seen in the serous and mucous membranes. Pleurisy, peritonitis, pericarditis, local or general, are sure to follow upon tuberculosis of the respective membranes. In the mucous membranes, hyperæmia and catarrh are the necessary results. But in the tissues which are themselves undergoing transformation into tubercle an obliteration of the blood-vessels proceeds very quickly. Tubercle, wherever formed, is non-vascular; the only approach to vascularity is when tubercle surrounds arteries or veins without closing them.

**V. Concerning the metamorphosis of tubercle.**—Sooner or later, the tubercles, which have now been described, undergo sundry changes. These changes sometimes take place very quickly, certainly within two or three weeks from the formation of the tubercle. On the other hand, tubercle may remain unchanged for a long time, even for two or three years, as Schüppel's observations upon one case seem to prove. There are two kinds of metamorphosis—the fibrous and the caseous, and they correspond to the two kinds of tubercle which Virchow describes, the fibrous and the cellular. 1st. *The fibrous metamorphosis* is by far the less common. The reticulum of the tubercle becomes greatly hypertrophied, so as to constitute a dense intercellular substance, interspersed with a few small spindle-shaped nuclei. The cells of the tubercle undergo the caseous change. The result is either a small fibroma with a cheesy centre (which may afterwards calcify), or a simple fibroma, the cheesy matter being wholly absorbed. In the writer's opinion, there is reason to believe that much larger tracts of tubercular infiltration may undergo the fibrous metamorphosis—may cicatrise, in fact. Be this as it may, the fibrous condition, when once attained, is permanent and final. Friedländer (1873) denies the fibrous metamorphosis altogether, and declares that it proceeds from the tissue around the tubercle, and not from the tubercle itself, which must caseate. 2nd. *The cheesy metamorphosis* is very much more common. All parts of the tubercle, first the cells and afterwards the reticulum, become infiltrated with oily molecules. This change begins in the very centre of the primitive tubercle. To the naked eye minute white specks appear; they become larger and more numerous, and at last coalesce. The oily change is incomplete: many of the cells simply lose water, dry up, and shrivel and in

this state they constitute the tubercle-corpuscles of Lebert. It is this addition of partial desiccation which makes cheesy degeneration differ from simple fatty degeneration. But why tubercle should take on the cheesy metamorphosis cannot be explained: the deficient supply of nutritious juices will not alone meet the case. The cheesy change usually begins before the tubercle has reached the size of a millet-seed. But sometimes much more minute granulations degenerate, and to this, the very smallest cheesy tubercle, Rilliet and Barthez have given the name of tubercular dust. The change begins much more quickly in generalised than in local tubercle. Large nodules, formed by the aggregation of smaller cheesy nodules, may reach the size of a peeled horse-chestnut. This caseous tubercle is the crude yellow tubercle of Laennec, and *the* tubercle of Bayle. Before Bayle it was called scrofulous matter, and looked upon as wholly a deposition from the blood. Unlike the fibrous metamorphosis, the cheesy change is not permanent: five further changes may occur. 1. Softening: the whole caseous mass breaks down into a molecular detritus of oily and albuminous particles. When the supply of blood allows of it, these molecules float in a serous fluid, which to the naked eye looks purulent: curdy pus, or a tubercular abscess. The abscess, when superficial, bursts, and leaves a tubercular ulcer. When all the caseous matter has been cast off the ulcer may heal, and so the local disease come to an end. But usually the ulcer steadily enlarges, by the perpetual production and destruction of tubercles around it: this is phthisis, in the anatomical sense of the word. The cicatrix-tissue of tubercle has a tendency to contract strongly. 2. Capsulation: sometimes a capsule of dense fibrous tissue will form around the cheesy matter, whether softened or not. This is the encysted tubercle of Bayle. 3. Calcification: the oily particles become gradually replaced by carbonate and phosphate of lime. The different degrees of calcification are denoted by such words as mortary, chalky, stony. In itself, it is a permanent change; but ulceration may occur around, and thus the petrified tubercle be discharged. 4. Absorption no doubt occurs to some degree. Virchow believes that cheesy glands may wholly disappear in this way. If there be truth in the current doctrine respecting the infectiousness of tubercle, absorption is, of all the terminations, the least to be wished. 5. Sloughing in mass may occur. The cheesy nodule becomes a sequestrum, which is gradually loosened by surrounding suppuration, until it separates, and lies loose in a cavity. The cheesy metamorphosis cannot be by any means looked upon as being peculiar to tubercle, although no doubt most common in tubercle. Simple inflammatory exudations, cancer, syphilitic gummata, lymphosarcoma, all sometimes undergo the same change.

VI. **Concerning the tubercular diathesis and dyscrasia.**—It was not possible that careful examinations of dead bodies should be made, without two prominent characters of tubercle being noted; namely, the fact that certain tissues, organs, or persons are liable to tubercle, and certain others not so; also the frequency with which tubercles are disseminated over a number of organs in the same subject. Hence arose the doctrine of tubercular diathesis and dyscrasia.

1. *Tubercular diathesis* is a phrase first used by Bayle (1803), and means a particular disposition to the generation of tubercles. The contradictory word to diathesis is immunity, or privation of diathesis. The tubercular diathesis relates to tissues, organs, or persons. (*a*) Tissues: it has been already shown that the connective tissues (and especially the variety lymphadenoid tissue) are particularly predisposed to tubercle. The other tissues—namely, the epithelial, and the higher, muscular and nervous tissues, may be said to possess complete immunity. Some would deny this last assertion, but their opinions have been narrated before, and need not be repeated here. Of late years tubercles have been found in sundry morbid tissues. Köster (1869), in cases of scrofulous disease of joints, found innumerable tubercles imbedded in the granulations; not only in those which spring from the synovial membrane and bone, but also in those which line abscesses or sinuses. Friedländer (1873) declares that, under these conditions, tubercles are never absent. They are visible, even to the naked eye, as whitish or greyish specks, surrounded by a ring of enlarged capillaries. He finds tubercles in scrofulous ulcers of the skin, and in the walls of scrofulous abscesses, cutaneous or connected with caries of bone. Köster has seen tubercles in chancrous and cancerous ulcers; Friedländer in the stroma of a cancer recurrent after operation. This local tuberculosis (if it be tuberculosis) has very little disposition to become disseminated; the health of the patients remains good; the tubercles often remain for a long time without becoming caseous. The microscopical structure of these tubercles is identical with that which Schüppel has assigned to tubercle of the lymphatic glands, and which has been already described. (*b*) Organs: the serous membranes (pleura, peritoneum, pericardium) are a very frequent seat of tubercle. Endocardium, very uncommon. Dura mater, not very common. Pia mater, very common. Ependyma, uncommon. The mucous membranes (alimentary, respiratory, genito-urinary), very common. Lymphatic glands, most common. Lungs, liver, spleen, kidneys, common. Suprarenals, not very common. Testes, not uncommon. Prostate, not common. Heart, not very common. Brain and spinal cord, tolerably common. Salivary glands and pancreas, uncommon. Ovaries, voluntary muscle, and thyroid, very uncommon. With regard to the skin, tubercles have been found around scrofulous ulcers; and Friedländer (1872–4) has assigned to lupus a microscopical character identical with that of tubercle. The diathesis of organs can be partly explained by the diathesis of tissues. Lymphatic organs are predisposed; and hence we can understand why the spleen is prone to tubercle whilst the thyroid is not; also why the intestines should be more liable than the stomach, because they are much richer in lymphatic structures. But it is not easy to say why the connective tissue of the ovaries, the mammary glands, and the salivary glands, should be indisposed to tubercle. Partly,

perhaps, it is an error of observation; partly, perhaps, it is explicable by the supply of blood and juices. (*c*) Persons: the tubercular diathesis, with respect to persons, is met with only in the scrofulous. No age is exempt from the possibility of tubercles; they are especially common in early life, and have been found even in the fœtus.

2. *Tubercular dyscrasia.* The word dys-crasia signifies a mis-composition, or a qualitative lesion. Strictly speaking, there may be a dyscrasia of any tissue, but the word has come to be applied to qualitative lesions of the blood only. The dyscrasia, which is believed to exist in tuberculosis, and to be peculiar to it, is called tubercular. Bayle was the first to note the frequency with which tubercle implicates a number of organs in the same subject and at the same time. Laennec remarked that the tubercles often seem to have been developed in distinct crops: the age of the tubercles being judged of by the degree of their degeneration. So that he came to speak of primary and secondary eruptions of tubercle. He noted that a secondary eruption often seemed to follow the softening of the primary tubercle. And this he deemed to indicate an actual and peculiar change in the juices of the part, a local dyscrasia: as if the primary tubercle were the source of an infection. It is then the multiple eruption of tubercle which suggests the notion of a dyscrasia. For the matter stands thus. The multiple eruption is either protopathic or deuteropathic. Either many organs simultaneously and spontaneously generate tubercle, or they are simultaneously subjected to a common tuberculising influence. Of the two hypotheses, the latter is certainly the more probable. And if so, it is not asking much to suppose that the common cause exists in the common bond of all organs and tissues—that is to say, the blood. And granting this, the further question arises: how does the blood acquire this tuberculising property? Is it protopathic or deuteropathic? Is it a spontaneous generation of the blood, or is it derived from some other source? Now, the prevailing theory of dyscrasiæ asserts that every dyscrasia is due to the constant afflux of morbid material derived from foci external to the circulating blood itself: in other words, dyscrasiæ are always secondary to a local lesion. The justification of this doctrine is believed to be found in certain dyscrasiæ which seem to be less obscure than the tubercular; for instance, pyæmia and melanæmia. Admitting that, in the case of the tubercular dyscrasia also, there is a necessary local antecedent lesion, we have next to inquire what this lesion is, both in itself and in its relation to the blood.

First, concerning the *nature of the lesion* which infects the blood. Dittrich (1853) taught that detritus, derived from the breaking-up of tissues of any kind, and entering the blood, would produce the tubercular dyscrasia. But to this doctrine it is justly objected that detritus, the result of degenerations, is often absorbed and is not followed by tubercle. There must be something peculiar to the detritus which sets up tubercle; what we may call a tubercular virus. Buhl (1857) held that this virus proceeded from the sundry forms of Laennec's tubercle alone: that is to say, from undegenerated tubercle, and from any kind of cheesy matter. He remarked, what is very true, that it is exceedingly uncommon to find disseminated miliary tubercle, without also finding cheesy matter somewhere, especially in the bronchial and mesenteric glands, and in the lungs. And no one would deny that the formation of the cheesy matter must have preceded, in point of time, the formation of the miliary tubercle. Against Buhl's theory there lie three objections, but they cannot be said to overthrow the theory by any means. Cheesy matter often occurs without the tubercular dyscrasia; but this proves nothing more than that cheesy matter sets up the dyscrasia under certain conditions only, or that all cheesy matter will not set up the dyscrasia. In very rare cases of general tubercle no cheesy matter has been found; but it is not denied that recent undegenerated tubercle may infect. The last objection is this: the tubercular dyscrasia implies the tubercular diathesis; and it is not surprising that the signs of former tubercular disease, in the form of cheesy matter, should be found in persons who have died from a more general tuberculosis; but this objection will lose much of its force when we have discussed our second topic, which we will now proceed to do.

The *relation between the local lesion and the blood*, or the mode in which the tubercular dyscrasia is developed. There are three possible ways by which the blood may become contaminated. First, by a lesion of some part of the sanguiferous system: but this, so far as the writer knows, has never been supposed the source of tubercle. Secondly, by an absorption of the virus by the blood-vessels: nothing can be said for this supposition or against it. Thirdly, by means of the lymphatic system: a source of infection which is highly probable. Experience seems to justify the following theory. The local tuberculising lesion first of all infects its immediate neighbourhood, through the juice canals. In serous membranes, mucous membranes, the lungs, and the brain, it is very common to see what may be called the mother tubercle surrounded by a number of daughter tubercles. The lymphatic glands are next infected; and when they have become tubercular, they pour tubercular virus into the blood. The blood conveys the virus to all parts of the body, and thus disseminates the tubercle. This theory is satisfactory on the whole, but it takes the primitive local lesion for granted. When we ask for the cause of the specific local lesion we are thrown back upon the tubercular diathesis, which we know only in its effects, not at all in itself, and not much more in its antecedents.

VII. **Concerning the experimental pathology of tubercle.**—Passing over the earlier experiments of Cruveilhier, Lombard, Erdt, and others, we will come at once to Villemin (1865), who was the first to draw general attention to the present topic. He inoculated rabbits with fresh tubercle, both transparent and opaque; that is to say, he inserted small pieces of tubercle into an incision made through the skin of the animals. When the rabbits were killed, about a month afterwards, an abundant crop of tubercles was

found in many of the viscera. On the other hand, Villemin proved that rabbits are not subject to spontaneous formation of tubercle. He concluded that tubercle contains a peculiar virus, which can be reproduced in the body. Since Villemin's time many pathologists have worked at the artificial production of tubercle. The results of their work may be conveniently arranged under six heads.

1. Animals used in the experiments. In rabbits, guinea-pigs, oxen, sheep, goats, and monkeys, artificial tubercle is easily generated; in cats and dogs, not easily. Villemin failed in his attempts to inoculate a cock and a dove.

2. Material inoculated. Villemin used fresh tubercle. But soon afterwards (1867) Andrew Clark and Waldenburg succeeded in rendering rabbits tubercular, by inoculating them with materials other than tubercle. It was next found that not only animal tissues, but even the vegetable, such as a cotton seton or a piece of cork, could set up tuberculosis. And, lastly, the fact was discovered that a simple wound, into which nothing was inserted, would suffice to generate tubercle in rabbits, guinea-pigs, and certain other animals. However, Sanderson (1868) showed that, of all the means for producing artificial tubercle by inoculation, none is more certain or more active than the material taken hot from the diseased glands of a living animal already infected. The dose required is almost infinitesimal. If a diseased gland is squeezed into a little distilled water in a capsule, and the slightly turbid liquid injected, results are certain. Both Sanderson and Wilson Fox (1868) discovered that when non-tubercular matters are inoculated, they become encapsuled by cheesy matter formed beneath the skin; so that the difficulty of explaining the subsequent tuberculosis is not so great as it seems at first. The tubercles follow, not the material inoculated, but the inflammatory products which surround it. Cohnheim inferred that the infectious matter was always caseous pus. But the inflammatory products around the wound of inoculation are not always cheesy, although they are usually so. Wherefore we must conclude that the infectious virus, which excites the general tuberculosis, is not introduced from without, but is generated by the animal itself; that the animal must possess a tubercular diathesis; and that, given the diathesis, any kind of inflammation, set up in any way, may call forth tuberculosis.

3. Manner of introducing the exciting substance. Villemin inoculated the tubercle. He also succeeded by injecting a watery suspension of tubercle into the air-tubes. Feltz (1867) injected cheesy detritus into the right side of the heart, and produced, in the lungs, embolic nodules which underwent caseous degeneration. Injections into the left side of the heart caused similar changes in other viscera, especially the brain. Lebert and Wyss obtained the same results from injections into the veins. Sanderson injected the serous cavities. Chauveau (1868) found that infectious matters may be introduced into the body through the alimentary canal: he rendered calves tubercular by feeding them with small quantities of tubercle, or with muscle, milk, or sputa of a tubercular animal. Lastly, some have suspected that infective particles may be inhaled into the lungs.

4. Lesions produced. The results of inoculation beneath the skin of guinea-pigs have been well described by Wilson Fox. (*a*) The material inserted becomes surrounded by dry cheesy stuff, which is shown by the microscope to consist of dried-up detritus, rather than true puriform cells. (*b*) Around the cheesy mass are a number of small round granulations, some transparent and some opaque, in size from that of a poppy-seed to that of a hemp-seed. These granulations consist of many nuclei, imbedded in a homogeneous substance, together with some large epithelioid cells. (*c*) Indurated cords reach, beneath the skin, from the seat of injury towards—or to—the nearest lymphatic glands. These cords are sometimes cheesy in the centre. Microscopically they consist of strings or rows of cells and nuclei, like those of the granulations, contained in a limitary membrane. These cords are probably altered lymphatics. (*d*) The next change is found in the associated lymphatic glands. They are enlarged to twice or thrice their natural size, and are also apparently much increased in number—that is to say, very small glands become visible. On section, they look semi-transparent and confused in structure: scattered through them are spots and streaks of cheesy degeneration. The microscope shows a great increase in the number of the natural lymphoid corpuscles, and some larger epithelioid cells. (*e*) The lungs are next most frequently affected. They contain scattered granulations of different sizes, from the minutest speck to the size of a hemp-seed, or even larger; semi-transparent and firm, with a cheesy centre, sometimes softened. A distinct connection with the air-tubes and vessels can often be made out, the granulations being seated in the peribronchial or perivascular sheath; but sometimes they have no particular relation to either. From these granulations proceeds an infiltration of the septa of the air-sacs: and concurrently with this change, the capillaries collapse and cease to be permeable by blood. The bronchial glands also are affected, in the same manner as described above. (*f*) The next most important changes are in the liver. It is much increased both in size and weight, in consequence of a diffuse infiltration of the capsule of Glisson and the tissue between the acini, with small corpuscles (such as before described) imbedded in a fibrous network. The new tissue looks semi-transparent and glistering: scattered through it are spots of cheesy change. Here and there the lesion tends to assume the nodular form. The proper liver-cells degenerate and disappear. (*g*) The spleen is enlarged. Nodules, transparent or cheesy, and transparent diffuse infiltrations, are scattered through it. (*h*) In the agminated and solitary follicles of the intestines are sometimes found white or caseous nodules, or even ulcers. The stomach is unaffected. The lymphatic glands in the mesentery and in the hilum of the liver are usually affected. (*i*) Ascites is common, and probably due to the state of the liver. (*j*) In the omentum numerous granulations are often found, both around the small vessels, and also in the tissue where there are no vessels.

Sanderson found that when the serous cavities are injected with tubercle the membranes become studded, in two or three weeks, with granulations, small, but visible to the naked eye; and, for the most part, mere overgrowths of lymphadenoid tissue previously existing beneath the epithelium. The lungs undergo the change described by Wilson Fox, and also a pneumonic change, consisting in a filling of the air-sac with roundish cells, like those which are always found there in small numbers.

5. Nature of these lesions. The great majority of pathologists are of opinion that these lesions, thus artificially produced in the lower animals, are the same as those which we call tubercular in man. On the other hand, Friedländer holds that these artificially-produced nodules do not possess the structure of true tubercles, to which he holds a giant-cell to be essential. In his opinion, the nodules are nothing but disseminated chronic inflammatory nodules, with a disposition to caseate. He declares that in the lungs the lesion consists in nothing but miliary pneumonia, an assertion which is directly contrary to the experience of Wilson Fox and Sanderson. Friedländer refers to Sanderson's views upon the infective product of inflammation. But Sanderson does not draw so excessively sharp a distinction between tubercles and chronic inflammatory nodules as Friedländer does. Sanderson's doctrines deserve the closest attention. They may be summed up as follows: An inflammation which is more or less exactly limited in duration and extent by the original limits of the injury which has caused it, may, with scientific precision, be designated a simple or normal inflammation. An inflammation which spreads and endures beyond the direct and primary operation of its cause, which induces similar inflammations in other parts, and disorders the functions of the whole body, has in it something beyond the effects of the injury, and may properly be called infecting. In the latter case, material must have been discharged from the original focus, either by the absorbents or the veins, into the circulation. The remote effects of this infecting inflammation consist, partly in the springing up of new foci of inflammation along the course of the infected channels (the anatomical distribution of which secondary foci always distinctly indicates the source from which they have originated), partly in the occurrence of changes in the physical and organoleptic characters of the blood itself, of such a nature as to show that it is impregnated with the infective poison. When, in the lower animals, local infective inflammations are produced, either in the skin or peritoneum by the introduction of irritant substances, two distinct sets of consequences manifest themselves, namely, (1) a chronic disease, exhibiting in all respects the anatomical characters of tuberculosis, and consisting essentially in the overgrowth of certain tissues called lymphatic or adenoid, and in close relation with the lymphatic system; and (2) pyæmia, an acute disease, in which abscesses form. The difference between the rapidly-growing and suppurating nodule of pyæmia, and the slowly-formed caseating granulation of tuberculosis, is one not of origin, or even of structure, but of duration and development. Opinions such as these are held by other eminent pathologists—for instance, Chauveau and Rindfleisch. For a further development of the subject, in respect of human pathology, the reader may refer to the article on Scrofula.

6. Characters of the virus. Whether these nodules be modified inflammations or not, there can be no doubt of the dyscrasia. But little is yet known concerning the virus. Villemin supposed it to be liquid. Klebs declares that it is soluble in water, but not in alcohol. Waldenburg, Sanderson, Chauveau, and most other pathologists deem it to take the form of minute solid particles.

Klebs, Aufrecht, and Baumgarten describe the virus as being of the nature of a bacillus; Schüller and Toussaint describe it as being a micrococcus. More recently Koch has announced the discovery by him of a specific tubercular organism in tuberculous structures and in the sputa of phthisis. This organism is a slender, rod-shaped, motionless bacillus, which equals in length from one quarter to the whole of the breadth of a red blood-corpuscle. This tubercle bacillus differs from all known bacilli in remaining unaffected by the staining reagent vesuvin. *See* Zyme. S. J. Gee.

**TUBERCULAR ERUPTIONS.**—This term is applied to eruptions consisting of small prominences of the skin. The use of the expression is somewhat arbitrary, inasmuch as a small tubercle would fall under the denomination of 'pimple,' and a large tubercle under that of 'tumour.' Willan defines tubercle to be 'a small, hard, superficial tumour, circumscribed and permanent, or suppurating partially.' In this definition prominence and bulk alone are regarded; and, as a consequence, in his group of tubercular eruptions of the skin, Willan brings together an incongruous assemblage of superficial growths, wholly discordant in their nature, some being grave and some only trivial, and of which the greater part can only be dealt with under their separate heads. For example, he enumerates as members of this group:—'phyma, verruca, molluscum, vitiligo, acne, sycosis, lupus, elephantiasis, frambæsia;' and omits altogether that very important group of tubercular eruptions which are due to syphilis.

Erasmus Wilson.

**TUBERCULAR MENINGITIS.** — A form of meningitis dependent on the presence of tubercle. *See* Meninges, Cerebral, Diseases of.

**TUBERCULAR PHTHISIS.**—A synonym for one or more of the forms of pulmonary consumption associated with tubercle. *See* Phthisis; Tubercle; and Tuberculosis.

**TUBERCULOSIS.**—Synon.: Fr. *Tuberculisation; Tuberculose*; Ger. *Tuberculose; Tuberkelbildung.*—By tuberculosis is meant the production of tubercle. The anatomical and ætiological aspects of tuberculosis are discussed in the articles on Scrofula and Tubercle. The present article is devoted to the semeiotic aspect of tuberculosis, that is to say, to the signs whereby we discover the tubercular process in the living man.

We lay down two prime distinctions at the outset. First, although tubercle tend to be disseminated more or less widely, yet it commonly affects some one organ more than the rest, so that during life this organ alone seems to suffer. Wherefore tuberculosis is distinguished according to the organ most affected, a rule to which there is but one exception—namely, the form of tuberculosis which does not predominate in any part, which is a disease of the whole substance, which resembles typhus or enteric fever, and which will be described hereafter. Secondly, tuberculosis is acute or chronic; words which we take in their common meaning, without further definition.

In the article on tubercle will be found a list of the organs prone to tubercle. The signs of the corresponding local forms of tuberculosis are described in the appropriate articles. We speak of tubercular pleurisy, peritonitis, pericarditis, meningitis; tubercular disease of the fauces, of the intestines, of the larynx; pulmonary tuberculosis and phthisis; tubercle of the kidneys, of the genito-urinary passages; of the lymphatic glands, of the suprarenals, of the testicles, of the brain, of the skin, of the choroid, and of other parts.

Tuberculosis tends to be chronic. But some of its forms are acute, specially tubercular meningitis, tubercular pericarditis, acute pulmonary tuberculosis, and the typhoid form of the disease.

*Acute typhoid tuberculosis.*—The signs of this disease may be summed up thus: Fever, and the usual attendants thereof; without signs of local inflammation, or of typhus or enteric fever. Marked by the thermometer, the fever is not high, seldom rising above 103°. The face devoid of expression, pale or dusky. The patient heavy, loth to be disturbed, but answering to the point. Sleep disturbed; much dreaming. Progressive emaciation. Skin dry and harsh, no eruption. Tongue dry, sordes on teeth, thirst. Belly not distended: spleen large. Nausea, vomiting; bowels costive and stools pale or temporary looseness with yellow stools. Frequent short cough; no expectoration; no physical signs of disease in chest, except, perhaps, of slight catarrh. Pulse frequent and weak. Urine high-coloured. In a case such as this, probability would become certainty if tubercles were discovered in the choroid during life—a lesion which the writer has found after death. Trousseau says that headache more or less severe, and delirium more or less violent, may be present.

The onset is somewhat sudden; the duration, from three to six weeks; and the termination, death. We may suppose that slight forms of the disease end in recovery; but proof is difficult or well-nigh impossible.

Treatment.—The treatment of acute tuberculosis is the same as that of any severe fever; for instance, typhus. S. J. Gee.

**TUBULAR.**—A peculiar quality of sound, as indicated by its name, either elicited by percussion, or heard on auscultation, in certain conditions. *See* Physical Examination.

**TUMOURS.**—Synon.: Fr. *Tumeurs*; Ger. *Geschwülste.*



Definition.—In the broadest sense of the word, a tumour signifies *a swelling*, and must therefore include conditions so far apart as a phantom-tumour, a hypertrophied muscle, an abscess, a hernia, or a cancer; but in its more restricted sense its application is confined to *a swelling caused by some form of new growth.*

Classification. — The separation of new growths into benign and malignant, though very useful as an approximate clinical distinction, is not admissible in a scientific discussion. Nor again is one that is founded upon the seat or shape of the tumour sufficiently accurate for the purpose. This arrangement would involve such antiquated terms as parenchymatous or superficial, nodules, infiltrations, fungus-growths, &c. The true classification must depend upon the actual structure, that is, the microscopical character of the growth. Such a classification is the following:—

A. **Tumours composed of normal tissue of the adult human body, or of such a tissue very slightly modified.**—1. Fibroma, hard and soft, including cheloid; 2. Lipoma; 3. Chondroma; 4. Osteoma; 5. Papilloma (warts and corns); 6. Adenoma and glandular hypertrophies; 7. Lymphoma; 8. True Myoma, including myo-fibroma; 9. True Neuroma; 10. Angioma; and 11. Lymphangioma.

B. **Tumours consisting of some modification of embryonic connective tissue,** that is, the *Sarcomas.* 1. Round-celled sarcoma, including glioma; 2. Oval-celled sarcoma; 3. Spindle-celled sarcoma, large and small; 4. Alveolar sarcoma; 5. Mixed sarcoma; 6. Myeloid sarcoma; 7. Myxoma; 8. Osteo-sarcoma; 9. Chondro-sarcoma; 10. Melanotic sarcoma; and 11. Psammoma.

C. **Tumours consisting of a modification of epidermic, epithelial, and secreting-gland structures.**—1. Cancers; and 2. Rodent ulcer. These forms of new-growth are described in special articles. *See* Cancer; and Rodent Ulcer.

D. **Tumours consisting of an inflammatory growth.** — 1. *Simple.* — Granulation-tumours, exostoses, &c. 2. *Specific.*—Depending on syphilis, tubercle, struma, leprosy, glanders, and other conditions.

The inflammatory tumours included under this class do not come strictly within the scope of the present discussion; its various sub-divisions must be sought under the description of the diseases which give rise to them, in the several articles bearing their respective names.

E. **Cysts.**—This division is also dealt with in a separate article. *See* Cysts.

A. **Tumours composed of a normal tissue of the adult human body.**

In this class are included representatives of each of the primary tissues of the adult body. The members of it, therefore, differ widely in structure and appearance, but they are distinguished from those of the second and third classes by one important feature, namely, that though often multiple, they show little or no tendency to return after complete removal—that is, they are essentially *benignant.* To this may be added another less characteristic distinction, namely, that they have, consequently, but little tendency to ulcerate; and that, as a result, if they interfere

with life at all, it is by pressure on important organs, or in such an accidental way as by the bleeding which may result from a uterine fibroid, rather than by the production of direct constitutional disturbance.

1. **Fibromata.**—Definition.—Tumours consisting simply of fibrous tissue or some modification of it.

Varieties, Clinical Characters, and Microscopical Appearances.—Fibromata may be divided into *hard* and *soft fibromata.*

*a. Soft fibrous tumours.*—The soft fibromata are simple masses of connective tissue, occurring in the submucous or subcutaneous tissues, and generally, but not always, more or less pedunculated. In many cases there are overgrown papillæ on the surface; and overgrown and distorted glands of the skin or mucous membrane are often entangled amongst the meshes of the tumour. The *subcutaneous* variety occurs in all parts of the body, but is perhaps most common in the labia majora and the lower limbs; and to it the name of *molluscum fibrosum* has been applied. These tumours often contain a considerable amount of fat, and thus approach the lipomata. They often appear œdematous; and may undergo calcareous or other forms of degeneration. The *submucous* variety includes the simple polypi of the nose and ear. In these the fibrous tissue is somewhat modified; the ordinary connective-tissue cells, oval, oat-shaped, or branched, being imbedded in a more or less copious gelatinous (? mucous) matrix. Such tumours are nearly related, on the one hand, to the myxomata, and are covered by a mucous membrane corresponding to the region in which they occur—ciliated, for example, in the nose (fig. 102), and columnar in the intestine. On the other hand, they often contain in their interior the characteristic glands of the part they affect, and thus approximate to the adenomata. To the naked eye they have a gelatinous appearance. The reader will observe that the varieties of *elephantiasis*, a disease which presents a complex structure, are not included under this heading.

*b. Hard fibrous tumours.*—These tumours are made up of pure fibrous tissue, but it is very difficult to draw the line between them and some forms of sarcoma. They are firm, and always encapsuled, and often pedunculated. To the naked eye a section is white or pinkish, and presents an appearance as if its component parts were arranged concentrically round a number of points. This appearance is more marked on microscopic examination, which, while it shows this concentric arrangement in bundles that have been cut across, exhibits others which have been divided longitudinally (*see* fig. 101). Hard fibromata occur in many situations: in the subcutaneous tissue, including amongst others the fibrous tumours of the pinna, which are not uncommon in idiots, and some, at least, of that peculiar class of tumours called 'the painful subcutaneous tubercle'; in submucous tissues, including many of the naso-pharyngeal polypi, and some of the fibrous tumours and polypi of the uterus; in connection with the periosteum, including some of the forms of epulis, the so-called fibrous tumours of bone, and according to some authorities, though this is doubtful, some kinds of subungual exostosis; in nerves, including the common neuromata, and bulbous nerves in a stump; and in the intermuscular planes. They are liable to various forms of degeneration; they often calcify; and those in connection with the periosteum may undergo ossification. Some fibrous tumours cause serious danger to life from the position they occupy; it will be enough to cite the cases of naso-pharyngeal polypi, and polypi of the uterus.

Treatment.—Fibromata can only be treated, if interference of any kind be necessary, by complete removal, the nature of the operation depending upon the position of the growth. If completely removed they have no tendency to recurrence.

2. **Lipoma.**—Definition.—A tumour composed of normal adipose tissue.

Varieties and Clinical Characters.—Occasionally more or less local hypertrophies of the subcutaneous fatty layer occur, and merit almost the designation of a tumour; but the true lipoma is a pretty well-defined tumour, made up of a larger or smaller number of overgrown fat-lobules. These are sometimes of enormous size, so that only two or three are found in a tumour of considerable dimensions. The skin presents a very characteristic dimpling, when moved to and fro over such a subcutaneous fatty tumour. The superficial parts of the mass may generally be easily separated from the surrounding structures during an operation for its removal; but the deeper parts, often consisting of smaller lobules, and generally containing a vessel of some magnitude, require more careful enucleation. Fatty tumours are met with in all parts of the body in which adipose tissue is normally developed. The writer once met with a fatty tumour inside the spinal column. They may occur congenitally, but are more common in middle and advanced life. They are often multiple, and are apparently in some cases developed as the result of pressure; and sometimes they are remarkably symmetrical. They involve no danger to life, but are often very painful, as the result of pressure upon cutaneous nerves. Microscopically, the structure is that of ordinary adipose tissue.

Treatment.—Though fatty tumours are said to shift their position, and sometimes to diminish in size spontaneously, they are not to be dispersed by internal remedies or external applications. If necessary, they must be removed by the knife, an operation which, as was mentioned above, is usually easy. It is a remarkable fact that, unless they be completely removed, recurrence is not uncommon.

3. **Chondromata.**—Definition. — Tumours made up altogether, or in great measure, of cartilage.

Varieties, Course, and Clinical Characters.—Cartilage-tumours may be divided into those which grow in connection with a *bone*; and those which are developed in the *soft parts.*

*Cartilaginous tumours growing in connection with bone.*—These may be again subdivided into those which grow from the surface of the bone—*ecchondromata*; and those which grow from the interior—*enchondromata.* The latter are the simplest form of cartilage-tumours; they com-

mence usually during the period of adolescence, and affect by preference the fingers and toes, but are occasionally found elsewhere; they are almost always multiple, but never show a malignant tendency; they may reach a very considerable size; and they are generally coated with a thin layer of bony tissue. The *ecchondromata* are developed, as a rule, during a later period of life; are found in connection with any of the bones of the body; and often attain an enormous size. Some of these tumours, to which Virchow has given the name of *osteoid-chondroma*, such as are occasionally found forming elongated swellings in the shaft of a long bone, present a high degree of malignancy, recurring as such in distant parts of the body.

*Cartilaginous tumours of the soft parts.*—These tumours occur principally in connection with certain glands, and especially in the neighbourhood of the parotid, and in the testicle. It has been suggested that they may originate from some remains of fœtal structures. Rarer situations for such tumours are the submaxillary gland, the breast, the ovary, the lachrymal gland, the kidney, and, it is said, the lung. These tumours are comparatively seldom pure, but are usually mixed with myxomatous, adenoid, or sarcomatous structure; the degree of such admixture determining in great part the benignness or malignancy of the growth.

An account of the so-called *ossifying chondromata* is given under the heading **Osteomata.**

Naked-Eye Appearances.—Cartilaginous tumours vary very much in density; the hardest contain fibrous tissue, and are, in fact, fibro-cartilaginous growths; the softest are very soft, and are very closely related to the myxomata; indeed, it may be held that many myxomata are merely varieties of chondroma. Some chondromata soften, either in many parts or in the centre, giving rise to one or more cysts in the interior; the bursting of such may lead to a permanent sinus. Other forms of degeneration are not uncommon, and especially calcification. True ossification is not rare.

Microscopical Characters.—Microscopically the structure often differs widely in different specimens of chondroma, and in different parts of the same tumour; the matrix may be hyaline or fibrous; and the cells round, irregular, stellate, or much-branched (figs. 105 and 106). It will easily be understood that with a soft hyaline matrix and much-branched cells, the appearance of myxoma is very closely simulated.

Treatment.—Bearing in mind the great variety of these tumours, it will be seen that it is impossible to sum up the treatment of them in a few words. The simple enchondromata of the fingers should only be removed to cure deformity or similar inconvenience. As a rule, other forms should be removed as early as possible; but many chondromata spring from regions which are altogether beyond the reach of the surgeon's knife.

4. **Osteomata.**—Definition.—Tumours composed of bone.

Varieties.—If the inflammatory exostoses be excluded, such as those which are found round a joint affected with chronic rheumatic arthritis, or those which depend upon the ossification of a node, we may divide this class of tumours as follows:—

*a.* Osteomata developed as such on the exterior of a bone, including the ivory exostosis—*periosteal exostoses.*

*b.* Osteomata developed as such in the interior of a bone—*enostoses.*

*c. Pedunculaled exostoses.*

*d.* Osseous tumours of *the soft parts.*

*e.* Osseous tumours produced by the *ossification of other kinds of new growths.*

*f.* And lastly (though not strictly coming under the same category) the *odontomata.*

*a. Periosteal exostoses.*—These are irregular bony tumours, appearing usually in adult life; they are directly continuous with the bone from which they spring; and are composed sometimes of cancellous structure, with a thin coating of compact tissue, but much more frequently of denser material. They most often affect the bones of the face, where they produce horrible and distressing deformities: but are also found on the skull, in the meatus of the ear, or, more rarely, on the long bones. From the importance of the neighbouring structures it is, in most cases, impossible to remove them. Some of these tumours are of extreme density, and have hence been called *ivory exostoses*; these, when they affect the upper jaw, their commonest seat, must be distinguished from the *odontomata*, to be presently described.

*b. Enostoses.*—Enostoses need only be mentioned in order to point out their extreme rarity; but it may be remarked that many of the last-described series of tumours probably spring from the diploë of the cranial bones, and should thus, perhaps, more properly be included under this heading.

*c. Pedunculated exostoses.*—The pedunculated exostosis, or ossifying chondroma, is a subperiosteal chondroma, with a tendency to ossification, developed in young people, near the junction of an epiphysis with a diaphysis.

Pedunculated exostoses approach the spherical shape, but are sometimes irregular or flattish, and often tuberculated. The peduncle varies in its relative size, the growth being often nearly sessile. On section the tumour shows a layer of periosteum superficially; beneath this is a layer of cartilage, sometimes thick, sometimes almost imperceptible. The deeper part of the cartilaginous layer is calcified, and looks like imperfectly-formed bone. The centre of the tumour consists of true bone, with Haversian systems complete, and is directly continuous with the tissue of the bone itself.

The microscopical appearance answers exactly to the structure which is apparent to the naked eye (fig. 104).

Symptoms and Treatment.—These tumours occur most often near the ends of the long bones, but may be found elsewhere; in the scapula, for example. They are often multiple and symmetrical, and if multiple are often hereditary. In certain situations, as, for instance, on the inner side of the knees, they may cause much inconvenience, and for this reason, or from their size, they may require removal. This may be done freely if antiseptic precautions be adopted; otherwise the opening of the cancellous structure of

FIG. 101. Fibroma (Neuroma).

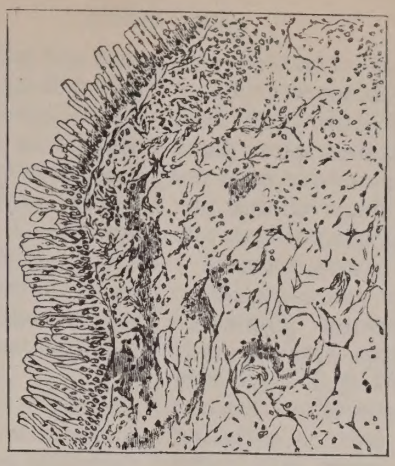

FIG. 102. Polypus of Nose.

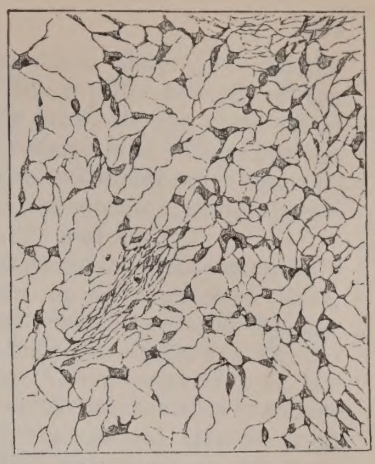

FIG. 103. Myxoma.

FIG. 104. Ossifying Chondroma.

FIG. 105. Enchondroma (of Jaw).

FIG. 106. Enchondroma (of Orbit).

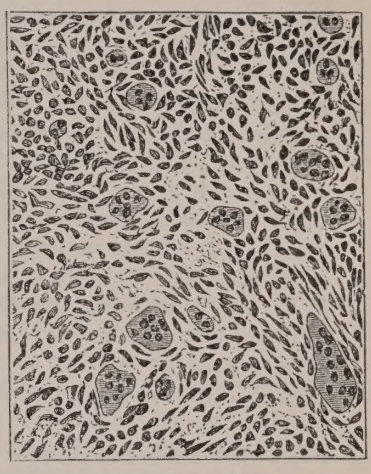

FIG. 107. Myeloid of Jaw.

FIG. 108. Large Round-celled Sarcoma.

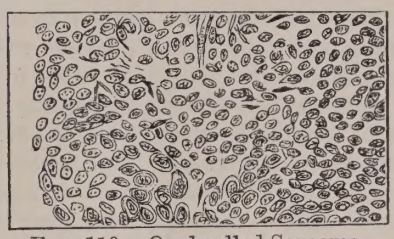

FIG. 110. Oval-celled Sarcoma.

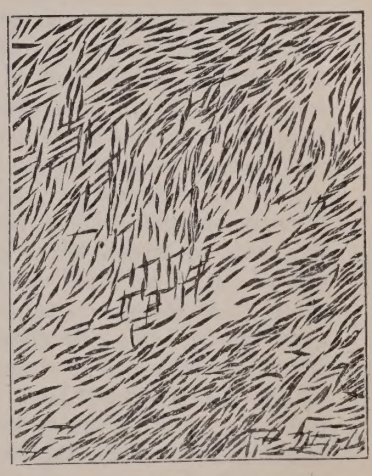

FIG. 112. Small Spindle-celled Sarcoma.

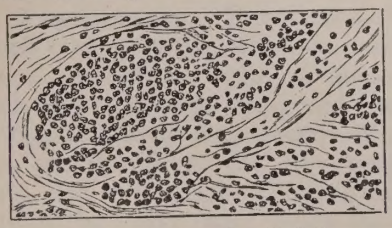

FIG. 109. Small Round-celled Sarcoma.

FIG. 111. Lymphoma.

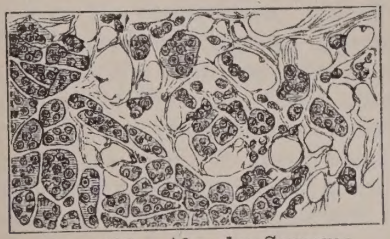

FIG. 113. Alveolar Sarcoma.

FIG. 114. Mixed Sarcoma.

FIG. 115. Melanotic Sarcoma.

FIG. 116. Large Spindle-celled Sarcoma.

*Drawings illustrating a Series of Tumours of the Connective-tissue Type. All drawn to the same scale* ( × 87 *diameters*).

the bone, and the danger of wounding the contiguous joint, may perhaps involve greater risk than the amount of inconvenience entailed by the tumour would justify. They have sometimes been either purposely or accidentally separated from their attachment by a blow, without inflicting a wound on the soft parts at all. Unless the whole cartilage-layer be removed, recurrence will probably occur, as growth of the tumour takes place by increase of this layer only, the process of calcification and subsequent ossification being secondary and, so to speak, accidental.

*d. Osseous tumours of the soft parts.*—These osteomata are also uncommon. They include such conditions as the following:—tumours springing from the periosteum, but not actually united to the bone; ossifying chondromata not connected with the bone; detached exostoses; ossification taking place in muscles or tendons, such as that which is occasionally met with in the adductor longus; and perhaps some other varieties of greater rarity.

*e. Osseous tumours produced by the ossification of other kinds of new growths.*—These are only secondarily, and often only partially, worthy of the name of osteomata; they are the result of a process of ossification taking place in tumours of a different nature originally, such as fibromas or sarcomas. It must be remembered that, while calcification of new growths is a common form of degeneration, the occurrence of true ossification is very rare.

*f. Odontomata.* — Odontomata are tumours composed of one or more of the constituents of the teeth. The simplest variety consists of a sort of exostosis from the fang. These are usually of small size, and may extend from one tooth to another. Such tumours are composed altogether of cement. The other kind is more or less covered with enamel, and contains dentine and cement in varying proportions; these, the true odontomata, may sometimes attain a very considerable size.

**5. Papillomata.**—Definition.—Papillary and villous over-growths, whether occurring on the mucous membrane, skin, or serous membrane, which do not present malignant characters.

Varieties and Symptoms.—Mucous papillomata are found on the lips, tongue, and soft palate, and in the larynx; in the intestines, especially at the lower part; round the anus (condylomata); in the bladder (the simple villous tumour); on the conjunctiva; and at the orifice of the female meatus urinarius. Epidermic papillomata include the warts and corns, and may occur on any part of the skin; those about the external genitals may reach an enormous size, and are frequently the result of gonorrhœa. The serous and synovial papillomata are more rare; under this class must be named the Pacchionian bodies, and the enlarged synovial fringes which are often the commencements of loose bodies in joints. Many papillomata are of syphilitic origin; others may be caused by local irritation, as, for instance, the dissecting-room wart, in which the papillary growth is accompanied by inflammation and suppuration beneath the skin.

Naked-Eye Appearances.—The naked-eye appearances vary very much with the locality in which the growth is developed; but they present this character in common, that they are obviously composed of the papillæ or villi of the part from which they grow, though these are of much more than the natural size. Those springing from mucous and serous membranes are soft, and usually moist on the surface; while epidermic papillomata are dry and hard.

Microscopical Characters.—Microscopically papillomata are made up of connective tissue, containing numerous vessels, covered by the characteristic epithelium or epidermis of the part (fig. 117, p. 204). The arrangement of the connective tissue and epithelial elements is a close imitation of that of the normal tissues from which they grow. The microscopical structure of the benign polypus of the intestine (fig. 120, p. 204) is hardly to be distinguished from that of many malignant growths in this situation. *See* Cancer—*Glandular epithelioma.*

Treatment.—If affecting the larynx or bladder papillomata may give rise to distressing and dangerous symptoms, and may necessitate severe operations for their extirpation. Those which occur on accessible parts are generally removed without any risk, except such as arises from their great vascularity; and show, as a rule, but little tendency to recur after complete removal. The common wart, however, often gives great trouble; various caustics may be used, such as the acid nitrate of mercury, fuming nitric acid, caustic potash, acetic acid, or nitrate of silver, but while these remedies are sometimes efficacious, the warts will often recur with the greatest possible inveteracy. At the same time it must be remembered that they frequently show a most capricious tendency to spontaneous cure; the surgeon will sometimes be mortified at finding that while his energies have been devoted with but partial success to the cure of one or two out of an extensive crop of these growths, the remainder have, in the meantime, spontaneously disappeared. The cadaveric or dissecting-room wart is best treated in the early stages by soothing applications, and may perhaps be cured by the external use of belladonna: should this, however, prove unsuccessful, the employment of a caustic must be resorted to (*see* Post-Mortem Wounds). The best local treatment for condylomata and gonorrhœal warts is the application of some desiccating powder, such as dried alum. It is well to remember that warts which remain a long time uncured are apt to take on an epitheliomatous action; and not only so, but that any chronic irritation, whether from the application of insufficient methods of cure or other causes, is likely to lead to the same result.

**6. Adenomata.**—Definition.—An ill-defined group of tumours, a typical member of which is essentially non-malignant, and is made up of tissue exactly resembling that of the gland from which it springs; but the departures from the ordinary type are so many and so varied, and, at times, so indefinite, that it becomes impossible to draw a clear line between the adenomata and the carcinomata.

(*a*) *Adenoma of the Sweat-glands.*—This class is said to include some non-ulcerating cutaneous tumours (the tubular epitheliomata of some authors); and some ulcerating ones—the cancroids or rodent ulcers. *See* Rodent Ulcer.

(*b*) *Adenoma of the Sebaceous Glands.*—This is a rare tumour, growing on different parts of the skin; the most usual seat being the nose, when it receives the popular name of 'grog-blossom.' This forms a nodular purplish tumour, growing from the end of the nose, and often reaching an enormous size. When cut into it bleeds freely, and exudes from innumerable cavities in its interior an inspissated sebaceous secretion. *Microscopically* it is seen that the connective tissue and the vessels are hypertrophied, as well as the sebaceous glands. The *treatment* consists in removal by the knife; and cicatrisation generally occurs with wonderful rapidity. Recurrence is not uncommon.

(*c*) *Adenoma of the Mucous Glands.*—Under this heading might be included some of the simple polypi of the nose (*see* **Fibromata**). The best representation, however, is the simple polypus of the rectum; this is a sessile or pedunculated roundish tumour, occurring mostly in children and young subjects. It bleeds freely from the surface, and is often the cause of painful and somewhat troublesome symptoms, amongst which prolapsus ani is the most common. *Microscopically* it consists of tissue closely resembling that of the mucous membrane of the rectum, but the hypertrophied follicles are often imbedded in a tissue very similar to that which forms the basis of the mucous polypus of nose (fig. 120, p. 204). The *treatment* is by removal either with the knife or ligature, or some form of snare or écraseur. Recurrence does not, as a rule, take place.

As is stated in the article CANCER, and as is shown in figs. 120 and 121, p. 204, it is often almost impossible to distinguish, by their microscopical appearances, the simple adenomata of the large intestine from the malignant growths affecting the same structures. The same observation applies to many tumours of the jaws, such as that in fig. 128, p. 204, which, though classed amongst the adenoids, often exhibit a high degree of malignancy.

(*d*) *Adenoma of the Breast.*—The most typical adenoma of the breast is a rounded tumour of moderate size, occurring often at the margin of the gland and frequently near the axillary border, completely encapsuled, and consisting of tissue which hardly differs from ordinary mammary structure (fig. 130, p. 204.) It occurs usually in young women, often during the child-bearing period. It shows no tendency to recur after removal. A large number of adenoids of the breast do not, however, agree with this description, either as regards position or structure. In structure departure may take place from the normal type in two directions; by an excessive or abnormal development either of the epithelial or of the connective-tissue elements. In the former case the tumour, in proportion to its abnormality, approaches the cancers; in the latter it assumes more and more closely the characters of the sarcomas. Thus we find some of the softer adenomata, as shown in fig. 131, p. 204, exhibiting a tendency to recur after removal, in the same way as a carcinoma, and with an almost equal degree of malignancy; while others, presenting characters like those of fig. 132, p. 204, may follow the same course as a sarcoma, both as regards the manner of involving surrounding tissues, and the way in which they recur in the viscera. These latter are called *adenosarcomata*, and often attain an enormous size. If the stroma of one of these tumours be in large amount, and fibrous or myxomatous, the names of *fibro-adenoma* and *myxo-adenoma* may be applied. Adenomata often contain cysts, and these cysts not unfrequently intracystic growths. They must be treated by removal of the growth.

The reader must be content with the foregoing approximate description of this important class of tumours, the varieties in the nomenclature of which are equal to the number of the authors who have written on the subject. The writer believes that much unnecessary confusion has been caused by this multiplication of names, for a detailed account of which special works must be consulted, as their discussion would lead far beyond the limits of the present article.

(*e*) *Other forms of adenoma.*—Amongst other rarer forms of adenoma, bearing a more or less close relationship to the glands from which they spring, may be enumerated the following: adenomata of the testicle or ovary, of the salivary and lachrymal glands, of the liver, and some tumours of the thyroid. Tumours of the thyroid, however, are in most cases simply hypertrophies of the gland itself, and should therefore be classed with simple hypertrophy of the breast and ordinary enlarged prostate, rather than with the tumours now under discussion. It should be noted that many of the less typical adenomata, especially those of the salivary glands and the testicle, frequently are found in combination with other heteroplastic growths, such as chondroma, myxoma, or some form of sarcoma.

7. **Lymphoma.**—Under certain circumstances, for an account of which the reader is referred to the article LYMPHADENOMA, the lymphatic glands throughout the body become enlarged, forming tumours, often of enormous size. Occasionally these growths assume a more malignant character, involving the parts in the neighbourhood of the glands from which they spring, and being followed by the appearance of secondary growths in other parts of the body. To such a condition as this the term *lymphoma* has been applied. The glands are soft, and in the early stages easily moveable amongst, or removable from, the surrounding tissues; in colour they are a yellowish-white, as also are the secondary growths. *Microscopically* they show the structure of an ordinary lymphatic gland, which, it will be observed (fig. 111), differs from that of a small round-celled sarcoma only in the fact that the stroma is much more definite and characteristic.

8. **Myoma.**—DEFINITION.—A tumour composed of muscular tissue.

With certain very rare exceptions, the only form of muscle-tissue occurring as an integral part of a tumour, is the *unstriped* variety; and almost the only position in which this is found is in the so-called 'fibroma' of the uterus. This growth consists of a mixture of fibrous tissue, with plain muscular fibres in varying amount, usually exhibiting the concentric arrangement of its elements, which was described as characteristic of fibromas generally. Fibromata of the

uterus may form pedunculated tumours on the external or internal surface of the uterus, or they may not extend beyond the uterine wall. They give rise to a variety of special symptoms, and require special methods of treatment, which it is beyond the scope of this article to discuss. *See* WOMB, Diseases of.

*Striped* muscular fibre has been found in a few cases of congenital tumour of the kidneys, and the writer has also seen it in a fatty tumour growing inside the spinal canal.

9. **Neuromata.**—DEFINITION.–Tumours composed essentially of any form of nerve-tissue.

The majority of neuromas are really fibromas, that is, fibrous tumours developed amongst and around the fibres of the nerve from which they spring. The idiopathic forms are sometimes single, but generally multiple, of small size, very hard, and affecting usually the branches of a particular cutaneous nerve. The amount of pain and tenderness caused by these growths varies very much, but is sometimes excessive. A clinical feature of some use in diagnosis is the fact that they usually move readily in the lateral, but very imperfectly in the vertical direction. What may be called traumatic neuromata, are fibromas developed at the end of a divided nerve in a stump. These often cause excessive pain, and peculiar reflex phenomena, and show a remarkable tendency to recur after removal.

It must not be forgotten that less simple tumours not unfrequently affect nerves, such as the various forms of sarcoma, or myxoma. No special description of these growths in this situation is, however, required.

10. **Angioma.**—SYNON.: Teleangiectasis.

DEFINITION.—A tumour composed of blood-vessels.

Angiomata divide themselves naturally into those in which the *capillary* element predominates; and those which are chiefly made up of vessels of *larger* size.

*a. Capillary angiomata.*—DESCRIPTION.—These are the *nævi*, which, while they sometimes form tumours of some magnitude, often, as in the case of so-called 'claret-cheek,' involve no increase in the size of the affected part. Nævi are nearly always congenital, hence the term 'mother's mark.' They may be subdivided into *cutaneous* and *subcutaneous* nævi. The former are of a more or less bright red colour, and affect only the cutaneous structures; the latter, as seen through the skin, in cases where this remains unaffected, have a purplish tint, and may involve any of the deeper structures of the body. Very commonly, however, the subcutaneous nævus involves the skin as well. Nævi often grow with extreme rapidity, and though they involve no danger to life, may cause serious inconvenience and great disfigurement. Sometimes, however, they exhibit a tendency to spontaneous disappearance, and often they remain permanently stationary. They are liable to various forms of degeneration, notably the cystic, and the ulcerative or suppurative.

*Microscopically* a nævus is composed of large capillaries, amongst which are seen arterial and venous trunks of larger size. Between the vessels are found connective tissue or fat, and sometimes the special constituents of the skin, such as sweat or sebaceous glands. It must be remembered that the nævus-element enters rather largely into the composition of some other tumours, and notably of congenital moles (*benignant melanoses*).

TREATMENT.—Inflammation of a nævus generally leads to spontaneous cure; nature thus suggesting one of the best methods of treatment at the disposal of the surgeon, namely, the injection of the tumour with some suitable irritant, such as carbolic acid. In adopting this line of treatment, it must be remembered that a danger exists of the irritating fluid entering a larger vessel, and by passing to the heart and setting up coagulation there causing instant death; this may be guarded against by the application of a temporary ligature. Other recognised and useful plans of treatment are the following:—the ligature, pressure, the application of caustics—and especially fuming nitric acid, galvano-puncture, puncture with the actual cautery, and complete excision of the mass.

*b. Cavernous angiomata.*—DESCRIPTION.—Those angiomata which are made up of larger vessels, and which are hence called the cavernous angiomata, from their resemblance in structure to erectile tissue, consist of cavernous spaces, communicating by smaller or larger vessels, and separated by trabeculæ of greater or less thickness and substance. These are the *pulsating nævi*, and perhaps some of the so-called *aneurisms by anastomosis*. They are of a more dusky colour than simple nævi, and often present a distinct thrill or bruit, which is perceptible both to the patient and to the surgeon. They are sometimes encapsuled, sometimes diffused; and in the latter case show an almost malignant tendency to involve neighbouring structures. The pulsation is often a most distressing symptom to the patient, if the tumour be found occupying such positions as the pinna of the ear or the fat of the orbit, both of which situations are not at all uncommon for the occurrence of the disease. *Microscopically* a cavernous angioma presents fibrous trabeculæ, lined with the characteristic vascular endothelium, and in parts perhaps separated by layers of areolar or any other tissue which the tumour may be involving.

TREATMENT.—The treatment must be pursued on the same lines as that for the simple forms of nævus.

11. **Lymphangioma.**—DEFINITION.—A rare kind of tumour, which may briefly be described as a cavernous angioma made up of lymphatic vessels.

To this class belong, in all probability, the *cystic hygromas* occasionally met with congenitally, forming large masses in the neck, beneath the tongue, on the upper extremities, or, rarely, in other parts of the body. Our knowledge of the pathology and treatment of these tumours is at present very imperfect, and the literature on the subject is extremely meagre. The reader is referred, for an account of all forms of angiomata, to the fourth volume of Virchow's *Krankhaften Geschwülste*.

B. **Sarcomata.**—DEFINITION.—It is to be regretted that the term Sarcoma has not been allowed to slip out of pathological terminology. From the days of Galen almost to our own time it has served, in the hands of different authors,

to designate different classes of tumours, sometimes of the simplest, sometimes of the most malignant character. Virchow, however, has given a meaning to the word, which is now generally recognised by pathologists. He includes under *sarcomas* those new growths which, while they do not actually consist of any of the tissues of the adult body, are evidently built on the connective-tissue type, and consist of a modification of the connective tissue of the embryo. They are thus very closely related to some of the simple tumours, and indeed often include portions of some normal tissue, such as bone, cartilage, or fibrous tissue—a fact which necessitates the employment of complicated and confusing names, including *Osteo-sarcoma, Chondro-sarcoma, Fibro-sarcoma*, and such-like.

Microscopical Characters.— Histologically, then, a sarcoma is made up simply of cells of the connective-tissue type, which may assume very various shapes and sizes in different tumours, and which are surrounded by a varying amount of intercellular substance.

Clinical Characters.—Theoretically sarcomata should always be developed in one of the connective-tissue structures, and practically they are not very often seen to originate in a secreting gland. But a glandular origin is not by any means very uncommon, as indeed might have been expected when it is remembered that every gland contains a considerable amount of connective tissue. Sarcomas present all degrees of malignancy; but, as a rough rule, it may be stated that the higher the degree of development of the tumour the less likely is recurrence to take place after removal. In connection with this point it is interesting to note that each recurrence of a sarcoma often shows a more rudimentary structure, but at the same time a greater degree of malignancy.

Recurrence does not follow the same rule that has been observed in the case of cancer. The lymphatic glands often escape altogether, or are but slightly affected; while fresh tumours spring up in abundance in distant parts of the body.

Sarcomas increase in size in the same way as cancers, but in the less malignant forms are often surrounded by a more or less distinct capsule.

Naked-Eye Appearances.— The naked-eye appearances of sarcomata are subject to very wide variations. It may, however, be observed that they never present the hollowed surface on section which is characteristic of some cancers; and they do not, except in the case of the softest tumours, exude a milky juice on scraping. Sarcomata are well supplied with vessels.

Varieties.— 1. *Round-celled Sarcomata.*— These are the most rudimentary, and, as a rule, the most malignant of this class. They are usually soft—sometimes very soft, seldom encapsuled, and generally of a whitish colour. Formerly they were classed amongst the medullary cancers. They are made up of round cells, as the name implies, and have a tendency to group themselves into two classes, in one of which the cells are *small* and uniform in size (fig. 109), closely resembling those of granulation-tissue; and in the other large, and sometimes very large, and often somewhat irregular (fig. 108). The intercellular substance may be copious and homogeneous, in which case the tumour approaches the myxomata; or smaller in amount and fibrous, when, if the cells are small, it may be difficult to separate such a sarcoma from the lymphomata.

Under this head must be placed the *Gliomata*—soft medullary tumours connected usually with nerves, frequently with the retina, and occurring commonly in children. They show microscopically a delicate stroma.

2. *Oval-celled Sarcomata.*—This variety of sarcoma represents the next stage in advance from the simplest towards a more complex structure. They differ, in fact, but slightly from the round-celled growth, either in clinical or in microscopical characters (fig. 110), but may be looked upon as intermediate between these and the spindle-celled sarcomas.

3. *Spindle-celled Sarcomata.*—This class must be sub-divided into the *small spindle-celled* and the *large spindle-celled* varieties.

The *small spindle-celled sarcomata* are firm, whitish, well-defined tumours, which approach the fibromata, sometimes very closely, and which after complete removal show a comparatively slight tendency to recur. These were the *recurrent fibroids* of older writers, and are the *fibro-sarcomata* of the present day. *Microscopically* (fig. 112) they consist of broad interlacing bands of elongated cells, with but little intercellular material—a structure which does not differ widely from imperfectly-formed fibrous tissue.

The *large spindle-celled sarcomata* (fig. 116) is a softer growth, frequently supplied with a very imperfect capsule, generally pinkish on section, or stained in parts dark red from extravasated blood, and often showing cysts. It may occur in any fibrous structure, but is rather common in connection with the periosteum. The malignancy of these growths is much greater than that of the small-celled class. *Microscopically* they consist of very large nucleated cells, with long tapering tails, and but little intercellular substance. These are the *fibro-plastic* tumours.

4. *Alveolar Sarcomata.—Microscopically* this rare form of tumour (fig. 113) bears a superficial resemblance to that of a cancer. There is, that is to say, a coarse stroma forming alveolar spaces, each of which contains a variable number of large, round, nucleated cells; each space is, however, again sub-divided by a very delicate secondary intercellular stroma. This is only demonstrable on pencilling out the cells, which, unlike a similar process applied to a cancer, is a work of considerable difficulty. Alveolar sarcomas affect most commonly subcutaneous tissues primarily; they are apt to recur in other parts of the body, and ultimately in internal organs, but often run a very chronic course.

5. *Mixed Sarcomata.*—Tumours are often met with which present a mixture of the different structures just described. Such are conveniently called mixed sarcomata; and the term may with advantage be made to include those growths which contain, besides sarcoma-tissue, bone, cartilage, gland-tissue, and what not. The latter growths will necessitate the employment of such names as osteo-sarcoma, chondro-sarcoma, adeno-sarcoma, &c.

6. **Myeloid.**—Synon.: Giant-celled Sarcomata.—These tumours are best classed amongst the sarcomata. *Microscopically* (fig. 107) they present the following elements, one or other of which may greatly predominate: fibro-plastic or spindle-cells, oval or round-cells, and very large nucleated cells, the so-called 'myeloid' or 'giant' cells. These last are irregular or rounded collections of granular protoplasm, in which occur numerous clear oval nuclei, containing a well-marked nucleolus. The amount of intercellular substance is small. In a fresh scraping, the clear oval nuclei are set free by the breaking up of the giant-cells. To the naked eye a section of a myeloid tumour is pink or yellowish, but almost always mottled with darker spots, the result of extravasations of blood. Very frequently they present points of ossification or calcification, and not unfrequently cysts. They are very soft, and usually yield a thick juice on scraping. They generally originate in, or, more rarely, close to, the end of one of the long bones; probably most often in the medullary cavity or the cancellous structure. Another frequent seat is the alveolar border of the jaws, where they form the myeloid epulis. They occur most often in young people, and if the bone involved be removed completely or in great part, have no tendency to recur; but in rare cases they may exhibit a high degree of malignancy, recurring not only in other bones, but in internal organs.

7. **Myxoma.**—It is not easy to say whether myxomata should be classed amongst the sarcomata or amongst the simple tumours. On the one hand, the tissue of which a myxoma is composed finds no representative in the adult; but, on the other, they approach very closely some of the soft fibromata, and are nearly related to fatty tumours. At the same time a large number of myxomas appear to be actual chondromata.

*Microscopically* (fig. 103) a myxoma presents elongated or roundish much-branched cells, the prolongations of which intercommunicate freely. These cells are imbedded in a copious, homogeneous, transparent matrix. The structure thus resembles that of fœtal fat.

Clinically these tumours are very soft and elastic, strictly encapsuled, gelatinous, semi-transparent on section, and exuding a peculiar mucous juice. Myxomata are not malignant; and as a rule, if completely removed, do not recur locally. They may be found in many parts of the body, but perhaps most frequently in the subcutaneous tissue, in connection with some gland, particularly the parotid. Here, however, they are often mixed with adenoid and cartilaginous material. Not unfrequently myxoma-tissue is combined with that of an undoubted sarcoma, which necessitates the term *myxo-sarcoma*. These tumours may occasionally be mistaken for colloid cancers. Histologically some of the soft enchondromata resemble them very closely.

8 and 9. *Osteo-Sarcoma*; and *Chondro-Sarcoma*.—These forms of sarcoma have just been referred to under the head of *Mixed Sarcoma*.

10. *Melanotic Sarcomata*.—These tumours are, in the experience of the writer, usually of the mixed, round, and spindle-celled variety. Some, but not all, of the cells contain a brown pigment, but in very varying amount (fig. 115). This gives the tumour a brown or blackish appearance. These tumours, though often completely encapsuled, show a high degree of malignancy; but are often succeeded by a mixture of white and black tumours, or sometimes by white tumours alone. They are not uncommon in connection with the choroid of the eye, and as affecting the papillæ of the skin (malignant mole), but have often been met with primarily in other parts of the body. The secondary growths are often found disseminated through every tissue of the body, forming tumours in such situations as the intestine, of peculiar and characteristic appearance. It has been observed that in some cases of melanosis the presence of black pigment, accompanied with other morbid appearances, has been found in the blood and also in the urine.

11. **Psammoma.**—It is only necessary to mention this very rare tumour, which is found only in connection with the membranes of the brain. It is composed of flattened cells, and is characterised by the peculiarity of containing brain-sand in its interior. It seldom or never gives rise to symptoms.

12. **Teratoma.**—Mention must be made, in conclusion, of a form of growth, which does not come within the classification here selected. This is a congenital tumour not unfrequently met with in the region of the sacrum (*congenital sacral tumour*), but occasionally seen elsewhere; often reaching a size almost equal to that of the infant itself. In structure these tumours consist of various imperfectly developed fœtal or mature elements of the body mixed together in apparently great confusion. Various theories as to their causation have been propounded; such, *e.g.*, as that they consist of an imperfect attached fœtus, or that they originate from Luschka's gland; but we have not sufficient data at present to express an opinion on this point. Attempts at their cure by removal are attended with great danger.

R. J. Godlee.

**TUNBRIDGE WELLS**, in Kent.—Iron waters. *See* Mineral Waters.

**TUNNEL WORM.**—A synonym for the Sclerostoma duodenale. *See* Sclerostoma.

**TURGESCENCE** (*turgesco*, I swell).—A term applied to a swollen condition of a part, generally associated with fulness of the blood-vessels, as in the mucous membrane of the conjuctiva, the fauces, or the rectum. *See* Swelling.

**TUSSIS** (Latin).—A synonym for cough. *See* Cough.

**TUSSIVE.**—This word is applied to certain physical signs which are elicited by the act of coughing, such as *tussive fremitus* and *tussive resonance*. *See* Physical Examination.

**TYLOSIS** (τυλόω, I make hard or callous.) Synon.: Callosity.

Definition.—Thickenings of the epidermis, occurring on parts of the body that are habitually subjected to pressure or friction. Tylosis is found, for example, on the feet, from the wearing

of shoes; on the hands, from rowing or the constant use of some implement or tool; and on other parts of the body unduly submitted to pressure. A corn begins by being a callus or laminated corn, and only rightfully acquires the title of corn when it has forced itself at a given point against the derma, and has depressed the latter to a greater or less extent, thereby producing pain and suffering. Callosities are inconvenient rather than painful; but occasionally the inconvenience is so great as to make the resort to treatment necessary.

Treatment.—The best remedy under the above circumstances, is the removal or avoidance of the cause. Next to this, the hardened cuticle may be softened by soaking in hot water, or by means of a water-dressing, and afterwards scraped. Or it may be painted over with the liniment of iodine daily, until the excess of cuticle exfoliates in laminæ and flakes. In either case, the skin must be subsequently protected, in order to prevent it from retrograding into its former state.

Erasmus Wilson.

**TYMPANITES** (*tympanum*, a drum).—Synon.: Fr. *Tympanite*; Ger. *Windsucht*.—This word is associated with the distension of the abdomen that results from excessive accumulation of gas within its cavity. As a rule, the gas collects in the interior of the alimentary canal, especially the intestines; but in exceptional cases it occupies the peritoneal cavity.

Ætiology.—Tympanites is chiefly met with under the following circumstances:—1. In connection with certain diseases which, from their local effects, tend to paralyse the intestines, especially acute peritonitis, typhoid fever, and dysentery. 2. In cases of intestinal obstruction from any cause, but particularly when this condition is acute. 3. In certain low febrile diseases, accompanied with the 'typhoid state,' and tending towards a fatal issue, such as typhus fever, small-pox, erysipelas, and typhoid pneumonia. 4. As the result of perforation of the alimentary canal. 5. In certain cases of chronic disease of the spinal cord, of which the writer has seen a marked example. 6. In connection with hysteria, sometimes. In all these conditions, except where the gas escapes into the peritoneal cavity, the immediate cause of the tympanites is a paralysed state of the walls of the intestines; but there is often, at the same time, an excessive formation of gas.

Symptoms.—The symptoms of tympanites are due to the mechanical effects of the accumulation of air. The patient is usually conscious of the distension of the abdomen, and the sensation may amount to extreme discomfort or actual suffering and great distress, there being a feeling as if the abdomen must burst if the condition is not relieved. The mental state of the patient may, however, be such that he is unconscious of, or indifferent to, any unusual sensations. Breathing is often interfered with in various degrees, and the act may be very hurried, with a feeling of urgent dyspnœa. The heart is also liable to be affected, and its action more or less disturbed. The secretion of urine may be impeded, even almost to actual suppression.

Physical Signs.—These are usually very characteristic. 1. The abdomen is uniformly enlarged, often to an extreme degree; being of a rounded shape; equal and symmetrical in every part, unless there happen to be a portion of bowel unduly distended, and without any tendency to projection in dependent parts. The skin is stretched more or less, but there is no protrusion of the umbilicus. 2. The sensations on palpation are those of perfect smoothness and regularity, with tension or a drum-like feel. 3. Percussion gives a general tympanitic sound over the abdomen, and also brings out the drum-like sensation. If ths distension is extreme, however, the sound becomes more or less muffled and dull. Frequently the dulness of the solid organs in the abdomen is partially or entirely obscured, or is displaced upwards. 4. Change of posture produces no alteration in the physical signs. 5. There may be signs of displacement of the thoracic organs. It must be mentioned that tympanites may be associated with some fluid in the peritoneal cavity, or with other conditions, and the physical signs will be modified accordingly.

Treatment.—In the first instance, any direct cause of tympanites must be removed, if practicable, such as intestinal obstruction. If the symptom calls for direct treatment, relief may be afforded in some cases by applying heat over the abdomen; and administering internally such remedies as brandy, aromatic spirits of ammonia, the various ethers, camphor, musk, sumbul, galbanum, assafœtida or other gum-resins. Should these fail, enemata containing assafœtida or turpentine may sometimes be used with advantage. The passage of a long tube through the anus into the bowel, reaching as high up as possible, such as an œsophagus-tube, is often very serviceable. In extreme cases it is allowable to puncture the large bowel in several points by means of a very small trochar, and thus afford an exit for the contained gas.

Frederick T. Roberts.

**TYMPANITIC** (*tympanum*, a drum).—A peculiar drum-like quality of sound elicited by percussion (*see* Physical Examination). The term is also applied to the abdomen, when it is distended with gas. *See* Tympanites.

**TYMPANUM, Diseases of.** *See* Ear, Diseases of.

**TYPES OF DISEASE.** *See* Disease, Types and Varieties of.

**TYPHLITIS** (τυφλόν, the cæcum).—Inflammation of the cæcum. *See* Cæcum, Diseases of.

**TYPHOID FEVER** (τῦφος, stupor)—Synon.: Enteric Fever; Pythogenic Fever; Gastric Fever; Infantile Remittent Fever; Fr. *Fièvre typhoïde*; *Fièvre gastrique*; *Dothiénentérie*; Ger. *Typhus Abdominalis*.

Definition.—A continued fever of long duration, usually attended with diarrhœa, and characterised by peculiar intestinal lesions, an eruption of small rose spots, and enlargement of the spleen.

Ætiology.—In common with other continued fevers, typhoid fever is due to the introduction from without of a specific poison into a system more or less predisposed to the disease. The

nature and origin of the poison, and the modes in which it is propagated, are questions of extreme interest and importance, and they will be the first to be considered.

With regard to the origin of the poison two distinct views have been entertained: one that it is specific in its nature, and derived only from some pre-existing case of the disease; the other that, while usually produced in a person suffering from fever, it may also be generated anew by the decomposition of sewage, and perhaps of other forms of animal filth. The former of these views is associated with the name of the late Dr. Budd of Bristol; the latter, or pythogenic, hypothesis had its chief supporter in the late Dr. Murchison. Fortunately, the practical issue of both theories is the same, namely, that the great preventive measure is the prompt removal of fæcal matters, so that neither air nor water may be contaminated by them.

Klebs claims to have identified a specific typhoid bacillus, which he has found not only in the lymphatics and blood, but in the tissues; and it is probable that this discovery will be confirmed.

It is accepted on all hands that the typhoid poison is reproduced in the system during the fever, and that its chief, if not exclusive, outlet is in the intestinal discharges. There is no evidence that it is conveyed at all by the breath or perspiration, or by the urinary secretion. While, however, the contagium is present in the fæces, it has not apparently at the moment of their passage its full virulence, but requires for its complete development a certain period of time, and this is forwarded by some conditions, retarded or prevented by others. Warmth, stagnation, seclusion from open air, accumulation and concentration of the infected discharges intensify the poison, and it would seem that a small amount of typhoid evacuations may give rise to a large development of the contagium in excretory matters with which they become mingled, and even in milk to which they may obtain access. This increase by a sort of fermentation explains the autumnal prevalence of typhoid fever observed in large towns, and the association pointed out by Dr. Murchison between a hot and dry summer and a high fever-rate in London; the drains not being flushed by abundant rainfall, sewage accumulates and stagnates in them, and typhoid stools never being wanting, the specific fermentation goes on rapidly under the influence of the high temperature, and produces the poison in quantity and intensity. It is possible, however, to put another interpretation on facts of this kind, and to attribute the generation of contagium to fermentation of fæcal matters, independently of any specific germ introduced in typhoid evacuations. Such is, indeed, the basis of the pythogenic theory of origin of typhoid fever. It is impossible to reproduce here the discussion of the question as to the specific or non-specific character and source of the contagium. There is overwhelming evidence that as a rule the poison is derived from some previous case, and the only facts which seem to require the supposition of its independent origin are occasional outbreaks of fever in villages or isolated buildings which cannot be traced to any known source. On similar grounds, however, we should have to admit the origin *de novo* of small-pox and all other contagious affections, and it should be added that with increasing experience in investigations of this kind unexplained outbreaks become more and more rare. There are again many instances known in which water largely contaminated by sewage has been consumed for years without giving rise to fever, until the sewage has itself been contaminated by typhoid excreta, when an epidemic has at once broken out. So with regard to milk, impure water has been habitually employed in its adulteration without traceable bad effects; but when to this water typhoid poison has gained access, the disease has immediately begun to be distributed with the milk.

The modes in which typhoid fever is disseminated are various. It is rarely, if ever, transmitted directly from person to person. Medical men, clergymen, and others visiting those who are suffering are not attacked, nurses very rarely when proper precautions are observed. If, however, bed-clothes or carpets soiled by the evacuations are not removed, and still more where gross neglect of cleanliness and of decency is permitted, attendants will contract the disease.

The most common vehicle of the poison is drinking water, which may be contaminated in various ways, mostly through sewage. The water-supply of a town may be thus poisoned at its source, such as a river into which drains empty themselves, or a reservoir or well accidentally contaminated; or the pipes of distribution, when the supply is intermittent, may while empty become charged with sewer gases, or may even receive sewage; or excessive rainfall may, in villages and small towns, wash the contents of cesspools into wells. This same rainfall flushing the sewers of well-drained towns, and in them preventing the disease, has often thus a a contrary effect in town and country. In some places the subsoil water, permeating a bed of gravel, is at the same time the well water of a village, and a reservoir of its sewage. An imported case of fever will under these conditions poison almost the entire community. With these examples of wholesale dissemination of typhoid fever must be mentioned the so-called 'milk epidemics' already alluded to. A case of fever occurs at a farm, or among the employés of a dairy; from defective sanitary arrangements the water used at the farm or dairy becomes contaminated by the excreta; this is added to the milk as an adulteration, or, as is usually said, is used in washing out the cans, and in this way the poison obtains access to the milk, where apparently it must increase very rapidly. Hundreds of cases have been traced to a single dairy.

More commonly, perhaps, the occurrence of typhoid fever is traceable to the absence of proper sanitary arrangements in individual houses. Not to speak of cesspools and leaking drain-pipes allowing the basement to be sodden with sewage, sinks or water-closets may be imperfectly trapped, and sewer gas diffuses through the apartments or is drawn into the living-rooms by fires, or is forced into the house by pressure in the main drains, when the poison probably enters the system through the lungs. Or the waste-

pipe of the cistern is in direct communication with the drains, and sewer gases conveyed by it are confined in the space under the cistern-lid, and absorbed by the water used for drinking purposes, which conveys the poison. In connexion with these modes of dissemination it should be borne in mind that well-made and closefitting doors and windows may aid in compelling foul air to enter from the drains or subsoil, and that houses in elevated situations, and thus apparently well placed for drainage, are in greater danger from pressure of gases in the main drains.

It is again possible that emanations from a newly-opened drain, or cesspool, or foul privy, may communicate the disease by atmospheric contagion—though this is comparatively rare, it being understood always that typhoid excreta form part of the contents. But a drain open to the air throughout its course, however offensive, is not so likely to give the disease as closed and unventilated sewers; and sewage-farms, if at all well managed, are quite harmless.

It should be added that while, in this country and in Europe generally, all the evidence tends increasingly to confirm the dependence of typhoid fever on pre-existing cases, and the dissemination by drinking water as its chief mode of propagation, observations and investigations in India appear to show either that typhoid fever can there arise independently, or at least differently, or that there is a disease not yet distinguished from typhoid fever which has a different method of rise and spread.

It is unnecessary here to discuss Pettenkofer's hypothesis that the varying prevalence of typhoid fever is connected with the varying level of the subsoil water, which as it rises displaces gases which have become saturated with poison from the soil into the atmosphere. It certainly does not apply to the facts as observed in this country.

One word must be said with regard to individual susceptibility to the disease, and with regard to predisposing causes acting on the individual. It is a matter of almost daily observation that some persons never contract typhoid fever, however much they may be exposed to the poison, while others take it readily; and it is almost equally obvious that certain families are extremely susceptible, and liable to have the disease in a severe form. It is always a reason to apprehend a formidable attack if a parent have died of the fever. Typhoid fever may occur at any age, but it is very rare in advanced life. It is probably more common in infancy than is generally supposed, as it is easily overlooked or confounded with common infantile ailments. The period of life at which the disease is most common is during adolescence and the first decade of adult age. Among the predisposing causes are mental depression or shock, over-work, debility, however induced. It is natural to suppose that unfavourable hygienic conditions would generate a predisposition, but doubt is thrown on this by the fact that typhoid fever does not by any means predominantly affect the poor. The influence of habitual consumption of impure water again is not very clear. In some instances it has appeared to make an epidemic severe, but, on the other hand, it would almost seem that the inhabitants of some towns, the water of which is constantly contaminated, acquire an immunity from the disease.

Anatomical Characters and Pathology.—Special interest attaches to the structural lesions which take place in typhoid fever, as they are closely associated with the symptoms, and are accountable for many of the complications which occur. The primary change is in the blood, but in this there is nothing characteristic. In fatal cases local congestions and inflammations are met with in the lungs and other organs, but the special and characteristic lesions are those taking place in the intestines and mesenteric glands. The intestinal mucous membrane of the ileum generally presents the appearances of acute catarrh; but the chief seat of the morbid changes is Peyer's patches, and the changes consist in a gradual infiltration of the glands here crowded together, followed by ulceration. The process is divisible into three stages—of *infiltration*, *ulceration*, and *separation* or *resolution*, each of which may be said, speaking roughly, to occupy a week. In the first, that of infiltration, the glands of Peyer's patches are swollen and distended by a corpuscular exudation. The entire patch is thickened and raised above the level of the surrounding mucous membrane; has a reddish, or fawn, or grey colour, according to the intensity and stage of the inflammation; and an irregular surface; is firm to the touch; opaque when the intestine is held up to the light, often showing through the peritoneal covering.

The patches are attacked successively from below upwards, and as they are largest and most numerous at the lower end of the ileum near the ileo-cæcal valve, it is here that the lesions are most extensive and most advanced.

In about a week the follicles begin to ulcerate, or, as it is sometimes said, burst. This marks the beginning of the second stage; as it progresses, the minute ulcerations extend and coalesce, the patch having first a worm-eaten appearance, and later becoming one large ulcer, which may be superficial or deep; in very severe cases the patches slough and fall off as a whole, a deep line of demarcation forming round them. At this period they are stained with bile, or when gangrenous are almost black.

During the third week in mild cases a sort of resolution may occur, the infiltrated material being broken down and absorbed; and this change probably takes place in patches high up in the ileum when in those lower down there is ulcerative destruction. For the most part this stage is occupied by the separation by ulceration or sloughing of the affected patches, and an ulcer is left of corresponding size and shape. Of course, as the patches run longitudinally along the aspect of the bowel, away from the mesenteric attachment, the ulcers also have their long diameter in the same sense. The superficial layer only of the mucous membrane may be ulcerated, or its entire thickness may be destroyed, and where there has been necrosis of a patch as a whole, the muscular coat may be implicated, and even in some cases the peritoneal covering. When the muscular fibres are laid bare, and especially when they are partially destroyed, the base of

the ulcer will have a shreddy appearance. Large vessels may be opened, giving rise to hæmorrhage; or perforation of the intestine may take place from necrosis of the serous coat, near the centre of the ulcer, and a perforation formed in this way will usually be large.

At the end of the third week the separation of the diseased patches will be completed, and the ulcerations left begin to granulate. There is for some time a liability to hæmorrhage from erosion of vessels, and perforation may still occur, the apertures now, however, being as a rule minute. Unless perforation has been preceded by adhesion to some neighbouring coil of intestine, which may possibly be the case at this period, the escape of gas and extravasation of liquid fæcal matter will set up general peritonitis, which is almost always fatal. The time required for complete healing of the ulcers varies.

Besides the large ulcers formed in the patches of Peyer, it is not uncommon to find small circular ulcerations scattered over the mucous membrane, and at times minute disseminated ulcers constitute the predominant lesion, Peyer's patches being absent, or if present, little affected. The large intestine is usually healthy or nearly so, the ileo-cæcal valve forming a sharp demarcation between healthy and diseased mucous membrane, but in some cases there are numerous small ulcerations in the cæcum and colon.

The changes in the mesenteric glands are secondary to those in the intestinal mucous membrane. The glands are enlarged, firm, pink or fawn-coloured, and present on section a corpuscular infiltration like that affecting the agminated glands. Later, they become paler and softer, and may gradually return to a normal condition, or may undergo caseation.

The spleen is almost always much enlarged, dark in colour, and soft.

Granular degeneration of the gland-cells of the liver and kidneys, of the muscular fibres of the heart, and of the voluntary muscles generally, is a constant morbid change. It is due to the prolonged high fever, and proportionate to its severity and duration; when it reaches an advanced stage, it may be the cause of fatal syncope from failure of the heart.

Symptoms. — The period of incubation of typhoid fever is not definitely known. There is great difficulty in fixing it, as the date of exposure to the poison can rarely be exactly ascertained, and the onset of the attack is usually insidious. It is certain, however, that the incubation-period is long, probably in most cases about twenty-one days. Instances are on record in which the disease appears to have come on immediately after exposure to powerful emanations from sewers which have burst, or have been opened on account of obstruction, but they are quite exceptional. The incubation is not attended by any marked symptoms; sometimes the appetite falls off, the tongue becomes furred, and there is headache or depression, but, as a rule, the patient is not debarred from his avocation, and there may be no complaint of any kind.

**Invasion.**—The invasion is almost always insidious; occasionally severe headache sets in suddenly, with depression, muscular weakness, general pains, and chilliness almost amounting to rigor; but, as a rule, the patient at first feels simply out of sorts, loses appetite, is indisposed for his usual work or for exertion of any kind. Epistaxis is not uncommon. The headache increases; the prostration becomes greater; sensations of cold down the back, alternating with heat and slight flushing, come on at intervals. At this point medical advice is usually sought, when the patient giving the above history will be found to present the usual indications of the febrile state—the pulse will be increased in frequency, the temperature raised, and the tongue will have a whitish or yellow coat, thick or thin in different cases. The bowels may be confined or relaxed; the urine high-coloured and diminished in quantity, or so far apparently normal.

In endeavouring at this early period to decide whether the case is one of enteric fever, the first thing to be done is to exclude local inflammation as a cause of the pyrexia. Among the positive indications the appearance of the patient is often a guide; he may look more heavy and oppressed than is accounted for by the temperature or the duration of the illness, and may be more prostrate. The tongue, as a rule, is not thickly coated, and the fur does not extend quite to the margins or tip, which even now may be unduly red. The abdomen may be tumid, and there may be some tenderness over the right iliac fossa, but the absence of these symptoms does not exclude enteric fever. The recurrence two or three times of slight epistaxis during the first few days of a severer attack would increase the presumption of the disease being typhoid. The temperature, however, if it is watched from the first, affords the most conclusive early evidence of the disease; it rises with remarkable regularity from day to day, and is from one to two degrees higher in the evening than in the morning; the appearance of the temperature-chart recording morning and evening observations is highly characteristic, and may, indeed, almost be called diagnostic. The opportunity of watching this gradual rise, however, is often wanting; but if, on the third or fourth day of an illness, without obvious local cause we find a temperature of 103° or 104° Fah., and especially if the evening rise and morning fall are marked, the probabilities are that the case is one of enteric fever,

As has been stated, the fever is of long duration, lasting from twenty-one to thirty days on an average, and probably the clearest idea of the course and progress of the disease will be conveyed by a brief description of the condition of the patient week by week, during an average attack.

At the end of the first week the temperature will have reached the level, whatever that may be, which will be maintained in the absence of complications, throughout the dominant stage of the disease—103°, 104°, or 105° Fah. in the evening, 1° or 1½° Fah. lower in the morning; in mild cases it may not be more than 102° Fah. when highest. The fever is now well-established, and all its characteristic features will be more or less pronounced. The initial headache will in most cases have disappeared; the patient lies on the back or on either side; the face is flushed,

often presenting a bright patch on the cheeks, rarely dusky; the expression is good; the eyes are bright and observant; the skin is more or less hot, usually dry, but often moist at some period of the day. The pulse is frequent, 80, 100, or 120—short, large, and very often dicrotous. A short cough is common; and a scattered sibilus, heard on auscultating the lungs, is so frequent as to constitute a feature of the disease. The tongue will be moist, with a white or yellowish fur thinning off towards the edges and tip, where the mucous membrane is red, and the fungiform papillæ often conspicuous. The abdomen will be more or less tumid; and on pressure tenderness may be elicited in the right iliac fossa, and gurgling of liquid and gas may be felt in the intestine. It is to be understood that the gurgling is an incident attendant on diarrhœa, and is absent in cases where there is constipation. The spleen may sometimes be felt below the ribs, and when not reached from the left hypochondrium may give an enlarged area of dulness on percussion, but it will not yet have reached its full size. The characteristic spots may occasionally be found, but though they have been seen as early as the fourth or fifth day, they do not usually come out till after a week or more of fever. The bowels will mostly act loosely, and sometimes frequently, so that there is diarrhœa. The urine will be high-coloured and generally turbid. The motions will have a powerful and offensive peculiar odour; they will be copious, liquid, rather pale, yellowish or drab in colour, with flocculi. A familiar descriptive comparison is to 'pea-soup.'

A week later, that is on the 14th or 15th day, the disease will have told obviously upon the patient. He will lie mostly on his back, and little on his side. The face, still flushed, and presenting often the red patches on the cheeks, will begin to look worn and thin; the eyes, still bright, will be less observant. The hand may be unsteady when held out, and there may be slight twitchings of the lips. There may be restlessness or even sleeplessness, and very often delirium. It has been stated that delirium mostly sets in about the twelfth day, but the time varies greatly. At first the patient is confused on waking from sleep, does not quite know where he is, and appears to have been dreaming, but soon collects himself; later he fails to shake off the confusion of thought, and he may talk incoherently, may ramble, in fact, as it is said. At this period the delirium does not go beyond slight rambling, and it is rarely violent at any stage.

The pulse will be more frequent, less full, weaker; dicrotism is rarely well marked. The lungs will not have undergone much change; the sibilant sounds may be more numerous.

The tongue will be more characteristic; the fur will be represented by a thin yellow or brownish streak down the centre, while the tip and edges will be red and angry. There will be a tendency to dryness, and generally the entire tongue looks shrunken and pointed.

The abdomen will be larger and more tense, and the tenderness and gurgling in the right iliac fossa more marked; the spleen will be larger. Now the eruption may be expected to present itself, if at all, but it must be remembered that it is absent in a considerable proportion of cases—a proportion estimated by some observers at 30 per cent. The eruption consists of small pink spots, about the size of a pin's head, slightly raised and pointed, well-defined, and disappearing on pressure, or when the skin is stretched, to re-appear when the pressure is withdrawn. They are usually few in number and are distributed irregularly over the abdomen and chest; but sometimes they are very profuse, the number having no relation whatever to the severity or character of the attack. The spots do not all come out at once, but in successive crops, till the end of the fever; the duration of individual spots, as observed by surrounding them with a ring of ink and dating them, being about four days. It has been recommended that the back should be searched for spots, but conclusions from eruption found here only would be unreliable, as the back is seldom free from spots, and there is nothing very peculiar in the spots of typhoid fever to distinguish them from others.

If the case is characterised by diarrhœa, it is usually at this period that it begins to be most troublesome; the stools have the appearances already described.

The temperature will be maintained at about the same height as at the end of the first week, but not uncommonly there is about this time a deceptive remission of fever, and it is perhaps worthy of remark that the active ulceration is now coming to an end. The fever which persists after this period has indeed been attributed to septic absorption from the intestinal ulcers—with doubtful justice, however.

It is from the later part of the second week onward that complications, both local, such as hæmorrhage or perforation from ulceration and separation of sloughs, and general, such as pneumonia, are to be apprehended.

The end of the third week finds the sufferer at his worst. If he is now able to turn in bed and to lie on either side, and if other symptoms correspond with this indication of power, the case is favourable. In a severe attack he will lie on his back, and probably tend to slip down in bed. The face may be either pale or dusky; its look will be that of prostration. The patient is mostly very deaf, often dull of apprehension, so that he is with difficulty made to put out his tongue; he may be half unconscious, or in the condition of coma-vigil, a stuporous sleep with the eyes half open; or he may be restless, with muttering delirium, picking at imaginary objects in the air, or at the bedclothes. Sometimes the slightest pressure on any part of the body appears to give pain, or the patient may start in great alarm when spoken to. The body will be emaciated; the skin thin, pale, dry, and harsh; the muscles wasted; the tendons starting up, from sudden irregular muscular contractions (*subsultus tendinum*) when the limbs are at rest, while attempted movements are attended with jactitations and tremors; the lips tremble and the tongue twitches when the patient speaks or puts out the tongue. A tap with the end of the finger on the pectoral muscle will cause a small swelling to rise on the spot—the so-called 'myoidema,'

due to contraction of the degenerated fibres; it lasts for twenty or thirty seconds. The tongue is shrivelled, dry, brown, or even black, destitute of true epithelium, dry and shiny, or coated with sticky slime or with black sordes. Sometimes it cannot be protruded at all. The roof of the mouth will be similarly coated; and there will be sordes on the teeth, and perhaps on the lips.

The pulse will be small, soft, extremely weak, often very frequent—130 or upwards per minute in bad cases; the beats run into each other, and are not distinct, giving the undulatory sphygmographic trace. The heart is extremely weak: the impulse absent, or a mere tap; the first sound short and feeble, or altogether extinguished. The lungs exhibit evidence of hypostatic congestion, impairment of resonance, and imperfect entry of air all over the posterior aspect of one or both sides of the chest.

The abdomen will usually be distended; spots may be present and continue to come out. There may or may not be diarrhœa. The stools may be passed unconsciously; and there may be retention, or more frequently incontinence, of urine. Bedsores often form rapidly, unless the nursing is both careful and skilful.

A tendency to recovery is usually indicated by improvement in the temperature, pulse, tongue, and abdomen. The temperature gradually falls, but at first this is shown chiefly by the increasing morning remissions, giving a greater difference between the morning and evening temperatures, and showing on the chart greater zigzags; the evening temperature then begins to fall day by day. The pulse becomes less frequent, and more full and distinct; the tongue gradually cleans, beginning at the margins; the abdomen subsides, the diarrhœa ceases; and strength returns little by little. In fatal cases the mode of death, when not due to some complication, may be by asthenia, or more frequently by coma and asthenia combined; hyperpyrexia is not uncommon as a phenomenon of the moribund condition; and as the heart fails, hypostatic congestion of the lungs is usually very marked.

**Relapses.**—Relapse is very common in enteric fever. It usually occurs about ten days after the subsidence of the temperature in the primary attack, and is sometimes attributed to premature administration of solid food, but more commonly has no such cause. A true relapse is not merely a recurrence of pyrexia, but a return of all the phenomena of the fever. Fresh Peyer's patches are attacked, and there is frequently a fresh outbreak of the spots at about the same period after the initial symptoms, or often earlier. The relapse, however, is rarely as long as the original fever; very commonly, indeed, the third stage, that of so-called infective or pyæmic fever, is wanting, and when this is so, it is probable that there is no ulceration of the intestinal glands. Fortunately, also, it is not so often fatal as might be expected, seeing that the patient is reduced by the first attack. A second or a third relapse may take place; the writer has even indeed seen a fourth, the patient recovering, and surviving five distinct attacks of fever, each of which was severe. No satisfactory explanation of the relapse of typhoid fever has been given. It has been said that there is a re-infection of the subject by poison lodged in the mesenteric glands, but it is not easy to understand why he should be susceptible to the influence of the poison from this source, when for the most part the susceptibility to the disease is exhausted by an attack.

**Special Symptoms and Complications.**—These are so numerous and varied that it has been thought better to describe them separately, rather than to interrupt the account of the fever.

*Hæmorrhage.*—This occurs in about 6 or 8 per cent. of the cases. It may come on as early as the tenth day, but more commonly it is between the fourteenth and the twenty-fourth days, and in the later rather than the earlier part of this period; bleeding may be provoked by imprudence in diet, or by exertion later still. The hæmorrhage is due to the erosion of some vessel during the ulceration of Peyer's patches, without protective plugging by fibrin, or to vessels being laid open by the detachment of a slough. The quantity of blood lost, and the rate at which it is poured out, vary greatly. Sometimes the fact of hæmorrhage having taken place is only known by the stools being black, sticky, and offensive. At other times the blood is discharged in large clots, or it may be extravasated so rapidly that it is liquid and red, not having had time to become blackened and coagulated by the intestinal contents or secretions. When the hæmorrhage is considerable, the patient is rendered pale and pulseless. The temperature always falls, and not unfrequently the loss of blood can be recognised before it appears in the stools by this fall of temperature, and by the pulse and general appearance of the patient. It is said that severe and persistent headache early in the attack is often followed by hæmorrhage in a later stage.

This complication is always attended with anxiety, and often exhausts the strength of the sufferer; but it is not by any means necessarily fatal. In many cases, indeed, the occurrence of considerable hæmorrhage marks the setting in of improvement; the temperature which falls on account of the loss of blood does not rise again; the patient becomes clearer and less heavy and oppressed; the tongue cleans; and all unfavourable symptoms gradually subside.

*Perforation.*—This, like hæmorrhage, may occur early or later; when early it is due to the entire thickness of the intestinal wall being implicated in the necrosis of the Peyer's patch, and the perforation may then be large. Later, at the end of the third week or afterwards, the perforation results from ulceration, and is often very minute. Unless adhesive inflammation at once glues the affected point to a neighbouring coil of intestine or to the abdominal wall, there is extravasation of intestinal gases and liquid into the peritoneal cavity, producing general and fatal peritonitis.

It might be expected that this occurrence would give rise to severe pain, but very often there is neither pain nor tenderness. The abdomen, however, rapidly becomes distended, often to an extreme degree; its walls are absolutely motionless in respiration; and on the application of the hand and making pressure, there

is not only tension but resistance of a peculiar kind, which is highly characteristic. With the local symptoms there are evidences of shock; great anxiety of countenance, which may be flushed and beaded with perspiration, or pallid and livid; extreme frequency of pulse, often 140, 160, or 200, which is small and weak; and very great frequency of respiration. The respiratory distress is so marked that, in some instances which the writer has been called to see, the perforation had been overlooked, and the condition attributed to some lung-complication.

*Peritonitis.*—Peritonitis, without antecedent perforation, is an occasional complication of typhoid fever. It differs from the peritonitis caused by perforation in the more gradual onset, and in the less urgent character both of local signs and general symptoms—of the latter especially.

*Tympanites.*—Great distension of the abdomen by flatus is not uncommon in the course of typhoid fever, coming on independently of peritonitis or perforation. Most frequently it gradually appears late in the disease, together with other symptoms of prostration of the nervous system, but it may set in abruptly within the first week, and it is then prognostic of an early fatal issue. Simple tympanites is distinguished from peritonitic distension by the difference in the feel to the hand; but chiefly by the fact that the respiratory movements of the abdomen are not suppressed, though, of course, impeded. Absence of pain is so common in the peritonitis of typhoid fever, that it is no criterion by which to distinguish inflammation from tympanitic distension.

*Diarrhœa.*—As has been stated, the bowels are usually loose in typhoid fever. Not unfrequently this looseness becomes excessive, and is thus a cause of exhaustion and a source of danger. Unless there is blood in them, the stools are more liquid, frequent, and copious, but not otherwise different from the usual typhoid motions.

*Albuminuria.*—Albuminuria is not uncommon as a complication of typhoid, and it may be accompanied with convulsions, though it is by no means so dangerous as in typhus. The albuminuria may be the effect of the poison or of the fever-processes on the blood, or it may indicate nephritis. In the former case, which is much more common, the urine does not differ in appearance from this secretion as usually seen at the stage of the disease at which it is present, and the albumen is only detected by examination; in the latter, the urine will be scanty and dark-coloured, as in desquamative nephritis, when it is not a complication of typhoid fever.

*Pneumonia.*—Inflammation of the lung may come on early or late in the course of typhoid fever. When early it is usually a lobar croupous pneumonia, not differing greatly from ordinary pneumonia; in the later stages it is often a combination of lobular catarrh with hypostatic consolidation. The symptoms are not marked. The temperature rises or is more sustained; there is increased frequency of the pulse and respiration, and perhaps obvious respiratory distress; the face may be flushed or anxious. As a rule, there is little or no cough or expectoration. Examination, when practicable, reveals the ordinary physical signs.

*Pulmonary gangrene.*—Gangrene of the lung may occur from obstruction of branches of the pulmonary artery by fibrinous coagula carried from the heart.

*Pleurisy.*—Pleurisy is occasionally met with as a complication of typhoid fever. It does not give rise to much pain, and may easily be overlooked, the condition of the patient precluding careful examination.

*Thrombosis.*—Thrombosis may be either a complication or a sequel of typhoid fever. It arises from the languid state of the circulation, and from the condition of the blood, which is liable to coagulate. The femoral vein and its branches are the vessels most commonly obstructed; there may be deep-seated pain and tenderness in the calf or in the gluteal region for a day or two before the large vein is affected. Thrombosis gives rise to pain and swelling of the limb, with some œdema, and the vein can usually be felt as a solid cord; there is a new access of pyrexia, especially if convalescence have already set in.

*Embolism.*—Embolism by plugs of fibrin deposited in the heart, and subsequently launched into the arteries, may occur in any part of the body. Hemiplegia may occur from this cause in the course of typhoid fever; or occasionally, but very rarely, gangrene of part of a limb.

*Parotitis.*—Parotid abscess is less common in typhoid than in typhus fever; but it may occur in very severe cases, and is then an additional source of danger.

Sequelæ.—Enteric fever always leaves the patient weak, and the debility lasts long. This is due not merely to the waste of tissue by the protracted fever, but to the fact that the intestinal and mesenteric lesions interfere with absorption of nutrient material. In some cases the patient never recovers strength, but gradually becomes emaciated, and dies from asthenia or from some intercurrent attack. Occasionally the ulcerations do not heal, and they may prove fatal after the lapse of a considerable time. Phthisis again may be started by an attack of typhoid fever, usually, but not invariably, in an individual predisposed to the disease. Insanity is another occasional sequel; the most common form of mental derangement is melancholia, but there may be acute mania. It may come on almost immediately, the patient never appearing quite to recover his faculties after the stupor of a severe attack; or it may develop itself at an early or late stage of convalescence, or not till a still later period.

Varieties.—To complete the account of typhoid fever, some of the principal deviations from the ordinary course and type of the disease must be enumerated, and in the first place it must be understood that, both in individual cases and in entire epidemics, typhoid fever may run its course without rise of temperature, the characteristic lesions being found after death. Again, there is sometimes so little general depression of strength that the sufferer may walk about, and carry on his usual avocations up to a late period of the attack. The term *typhus ambulans*, or *ambulatorius*, has been applied to such cases. The

writer has known several instances in which patients have *walked* into the London Fever Hospital with perforation.

**Infantile Remittent Fever.**—Infantile remittent fever is so called from the remissions often observed in typhoid fever affecting young children. No special description is necessary, the disease pursuing much the same course in children as in adults, only with greater fluctuations. Spots are less frequently seen.

**Typhoid Fever with Constipation.**—This really constitutes a distinct variety, the constipation persisting throughout, and not merely lasting for a few days and then giving place to diarrhœa.

**Bilious Fever** (*Fièvre bilieuse*).—This is recognised as a special form of typhoid fever by French observers, and deservedly so. The characteristic feature is frequent, sometimes almost incessant, vomiting of liquid containing bile, both after food and when no food has been taken. Severe headache often persists throughout the attack. The temperature does not, as a rule, rise high, and it fluctuates much; the face is pale and anxious; the pulse is frequent and very weak; the tongue is usually coated, and may be white or yellow. It is a very dangerous form of the disease, and may end fatally early by simple asthenia, without delirium or comatose symptoms.

**Typhoid Fever with Meningitis.**—True meningitis sometimes, though rarely, occurs at an early period of typhoid fever, and is attended with excitement, which may be maniacal in character, or violent delirium, and perhaps pain in the head.

**Abortive Typhoid.**—This is sometimes described as 'fourteen-day fever.' After well-marked symptoms of the attack, the temperature is not maintained, but gradually subsides. Such cases are mostly set down as common continued fever, or febricula.

Diagnosis. — A well-marked case of enteric fever at the height of the disease is easily recognised by the aspect of the patient, and by the symptoms already described: the red tip and edges of the tongue, the tumid abdomen, the enlarged spleen, the rose spots, and the character of the stools. In the early stage, however, it is often necessary to suspend the judgment for a day or two, and there may be difficulty in forming a definite opinion for a much longer period. The diseases which have most frequently been taken for typhoid fever are tubercular meningitis, acute pulmonary tuberculosis, and gastro-intestinal catarrh; typhlitis, catarrhal pneumonia and other acute affections of the lungs, glanders, pyæmia, and ulcerative endocarditis, have also from time to time been confounded with it. On the other hand, typhoid fever may possibly be taken for one of these affections, or may more easily be masked by some complication, such as pneumonia or peritonitis. What is most liable to happen is, that it may be entirely overlooked.

The insidious onset of typhoid fever is very characteristic, and, as has been said before, the thermometric chart of the first four days showing a rise day by day with the morning remissions, might of itself suggest the diagnosis. But occasionally the invasion is abrupt, or there is some pulmonary complication at the outset, which raises the initial temperature, so that it would be unsafe to rely too implicitly on the temperature. The first thing to be done in establishing a diagnosis of enteric fever, is to exclude local inflammation as a cause of the febrile condition, which will be effected by physical examination and other means. It must not be forgotten during this investigation that in pneumonia the consolidation may not occur for three or four days. When there is doubt, epistaxis will be evidence in favour of, herpes labialis against such a diagnosis, though herpes may break out when there has been a rigor. The presumption of typhoid fever arrived at by excluding local inflammation and other acute diseases, will soon be strengthened by the appearance of corroborative indications which we need not again specify, or be overthrown by their continued absence.

As regards the particular diseases enumerated as those with which it is specially liable to be confounded—in tubercular meningitis the temperature is not usually so high as in typhoid fever, the pulse is at first not very frequent, and is often hesitating, while it almost always presents the condition of tension, thus contrasting with the soft short pulse of fever. There are usually, but not constantly, headache and vomiting early in the attack, the bowels are mostly confined, and the abdominal wall is retracted. Squint, inequality of the pupils, or double optic neuritis, would be unmistakable indications of meningitis. In acute pulmonary tuberculosis there is more cough; and although at first there may be only scattered sibilant sounds, such as are heard in typhoid fever, these soon become more abundant, and other physical signs of the infiltration of the lungs are added, such as impairment of the resonance, and imperfect entry of air. The temperature also is usually more sustained. Gastro-intestinal catarrh in children is sometimes attended with so much febrile disturbance as to give rise to a suspicion, or even a diagnosis, of typhoid fever, especially as the abdomen is tumid, and there may be diarrhœa; over-feeding with milk may keep up the appearance of fever for some time. There are, however, intermissions and variations which, when carefully noted, are found to be inconsistent with continued fever; the tongue is more thickly and coarsely coated; and the stools, though they may be pale from undigested milk, have not the typhoid character. In typhlitis there is more local pain and tenderness, and a lower temperature; and the symptoms set in more abruptly vomiting being common. It is unnecessary to enter upon the distinction between typhoid fever and the other diseases mentioned; for the most part a few days will clear up any uncertainty or confusion.

As a matter of fact, errors rarely arise, when it is deliberately considered whether a given case is or is not one of fever. The danger is that the idea of fever may not be entertained at all, its symptoms being attributed to some slight local ailment. Or there is pneumonia or peritonitis as a complication, when the patient first comes under observation, which is not very uncommon among the poor or in hospital practice. The possibility, therefore, that typhoid fever

may underlie an acute local affection, should always be borne in mind, and when the desired crisis does not come on in pneumonia, or if in peritonitis the general symptoms are not altogether those of inflammation of the peritoneum, indications of enteric fever should be carefully looked for. When, again, a patient complaining only of some functional derangement, or of weakness and loss of appetite, has a look of illness and prostration which is disproportionate to the assigned cause, enteric fever should be suspected.

There is often great difficulty in distinguishing *infantile* remittent fever from tubercular meningitis on the one hand, and from gastric catarrh on the other. In gastric catarrh the tongue is more loaded; the temperature is less sustained and more irregular; constipation is more common than diarrhœa; and the evacuations, whether solid or liquid, have not the specific characters, but consist more of undigested food. In meningitis there will usually be purposeless vomiting, but not always; the temperature is not so high; the pulse is often slow or irregular, and the respiration shallow and sighing; the abdomen is not distended, and may be retracted; the bowels are confined. A squint would at once confirm suspicions of meningitis.

Prognosis.—It is never safe to speak confidently of the recovery of a case of typhoid fever, in view of the complications which may arise; but the prognosis is favourable or unfavourable, according to the antecedent condition of the patient, and to the severity of the attack, as estimated chiefly by the temperature. The mortality varies from 15 to 25 per cent., but there may be epidemics in which it may be throughout lower or higher than the average here stated.

Children seldom die of typhoid fever, and in the young the attack is less likely to be severe, and there is a better chance of recovery even when it is. In debilitated subjects, and especially in persons addicted to alcohol, typhoid fever is always attended with danger; even in a mild attack there may be failure of the heart, and pulmonary complications or thrombosis, which may prove fatal. Pregnancy also renders an attack dangerous. Apart from causes of anxiety in the general condition of the patient, and exception being made of cases in which the fever assumes the bilious type, attended with frequent vomiting of bile, headache, and prostration, and of the rare instances of meningitis as an early complication, the prognosis turns mainly on the temperature. If this is not more than 102½° Fah. in the evening, at the end of the first week, there is very little danger; on the other hand, if the evening temperature reaches 105° Fah., nearly half the cases prove fatal. When the temperature ranges high, it is of great importance to ascertain whether it is so for many consecutive hours, or only for a short period; a heat of 104° Fah. sustained for a great part of the day, is a more serious matter than a brief rise to 105° Fah. On this account, and also because the maximum may be attained at different periods of the day, it is desirable that the temperature should be taken in serious cases every two or three hours, or even more frequently. In typhoid fever as in other acute diseases, a contrast between the surface temperature and the temperature of the blood, as revealed by the thermometer, is of unfavourable significance. It with high temperature there are indications of failure, either in the nervous system or in the heart, the prognosis becomes serious; a tendency to stupor, or retention of urine early in the disease, is a bad sign; and acute tympanites at this period, indicating, as it does, paralysis of the muscular walls of the intestine, and presumably of the sympathetic nervous system, almost invariably points to a speedily fatal termination; the later gradual distension of the abdomen, ranks with the unfavourable signs, but is often met with in cases which recover.

Unusual frequency of the pulse, marked dicrotism early, and extreme weakness of the beat, and compressibility of the vessel later, intimate danger, as does also an increasing frequency day by day at the end of the third week. When the beats run into each other, and the pulse is a mere flutter, the danger is immediate and extreme. The sounds of the heart should be noted throughout the disease; the first sound, as heard at the apex, tends to become, first, short and sharp, then weak, and it may altogether cease to be audible; a good or bad first sound is of good or bad augury respectively. A systolic apex-murmur is not uncommon, and occasionally a distinct presystolic murmur is heard; these murmurs have no great significance, and usually disappear as the patient recovers.

Treatment.—The principles on which the treatment of typhoid fever should be conducted are generally accepted and well understood. Success depends greatly on their intelligent application to individual cases, and on careful attention to details at every stage of the disease.

The patient should, if possible, be placed in a large, airy, and well-ventilated room, the windows and door of which should be more or less continually open, according to the season and weather. The bed should not be too wide, and it should be approachable on both sides, so that the patient can be easily reached from either hand; it should be firm, but comfortable. A feather or flock bed is very objectionable, on account of the hollow into which the patient sinks in it. When practicable, it is a great comfort to have two beds, one for day, the other for night. The covering should be light, but sufficient to protect the patient from changes in the external temperature; eider-down quilting, or any material impervious to the insensible perspiration, should be forbidden; the under surface of such coverings will often be found quite damp, and exhaling an offensive odour. Conscientious, skilful, and efficient nursing is of the utmost consequence; and that nothing may be overlooked, a record should be kept of the condition of the patient, of the food, stimulants, and medicines administered, and of the evacuations passed.

The patient should be sponged night and morning with tepid water, to which a little vinegar or permanganate of potash may or may not be added. The temperature of the water may vary, the feelings of the patient being consulted, and the effects in producing sleep and quiet noted. The hands and face may be washed or bathed

frequently, and the general sponging may be repeated at any time when it seems to be required by heat and restlessness.

It is useful to habituate the patient to the use of the bed-pan from the first. It is true that very often the chair or utensil is used throughout; but in severe cases, or on the occurrence of hæmorrhage, the sitting posture is dangerous, and indeed impossible, and it may be most distressing to have to pass the excretions into the bed-pan for the first time under circumstances of extreme prostration; this may, indeed, destroy the patient's chance of recovery. A disinfectant solution should be placed in the pan or other vessel into which the stools are received, and more should be added before they are thrown away.

Perhaps the most important element in the treatment of typhoid fever is the regulation of the diet. This should be exclusively liquid, and the staple constituents will be milk, and beef-tea or broths of one kind or another. It should be borne in mind that these liquids are food, and not mere drinks, and they should be given with strict regularity. Two or three pints of milk, and a pint or pint and a-half of beef-tea or some equivalent, will be about the quantity required for twenty-four hours' consumption in the first instance; and it should be so divided that milk and beef-tea are given alternately about every three hours, judgment being exercised in waking up the patient if he is sleeping when food is due, or allowing him to sleep beyond the hour. The great tendency now, on the part of the public, is to over-feed cases of fever. When the patient asks for drink, milk is offered, and if it is iced or diluted with soda or seltzer water it is sufficiently grateful in quenching thirst, to be accepted in quantity altogether beyond the digestive powers; it then coagulates in masses, escapes solution by the gastric and pancreatic juices, and passes down the intestine in heavy curds, which irritate the ulcerated surfaces, besides producing other disturbances. It is in this way that milk has been discredited as an article of diet. The writer's experience is in accord with that of the late Dr. Parkes, who looked upon milk as the typical diet for enteric fever. In later stages of the disease it may be necessary to give nourishment more frequently, but the attention of the medical attendant will in most cases be required rather to moderate the amount of food given, than to urge its administration; it may, however, be found necessary to take precautions against neglect in this respect during the night. In emergencies concentrated meat-extracts may have to be given in teaspoonfuls every few minutes. The patient should, of course, be allowed to drink freely of cold water, toast-water, or any simple drink. The key to the regulation of the diet—it may almost be said to the management of the patient—is to be found in the careful inspection of the stools; the medical attendant ought to see every evacuation, or, at any rate, one motion every day, supplementing his own information by the report of a trustworthy nurse. When curds appear in the dejections, either too much milk is taken, or too much at a time, or its digestion is interfered with. If the passage of undigested milk is not remedied, there will certainly be flatulence, discomfort, and restlessness, elevation of the temperature, and in most cases diarrhœa. When without error in the administration of the milk, curds appear in the stools, dilution with soda or seltzer water, or the addition of lime-water or carbonate of soda, may prevent premature and unduly firm coagulation; or the admixture of arrowroot or of gelatine may cause the curds to be subdivided, and thus ensure their digestion. In some cases, on the other hand, beef-tea excites diarrhœa, and given in excess, it will almost always have this effect.

As the fever subsides, eggs beaten up, or lightly boiled or poached, may be added to the dietary. In all cases the return to ordinary diet must be made with great caution, bearing in mind the fact that there may be intestinal ulcerations unhealed, and it should be a rule that no really solid food be given till the temperature has been normal for a week; even at the end of this time it is not uncommon for the temperature to rise one or two degrees, after a moderate amount of fish or meat with bread has been taken.

It is an unfortunate aggravation of the sufferings in typhoid fever that fruit, which is so grateful when the mouth is dry and parched, cannot be given freely, on account of its liability to excite diarrhœa, but a few grapes may be permitted, care being taken that the skins and seeds are not swallowed, and the effects being carefully watched.

The question of stimulants is an important one. Here again the prepossession in the public mind is in the direction of almost indiscriminate administration of alcohol, and the importunities of friends may have to be resisted. The amount of brandy or wine given must therefore be carefully checked and controlled. In a large proportion of cases no alcohol is necessary from first to last; it is scarcely ever required in the early stages of the disease, except perhaps in drunkards; and at no period should it be given as a matter of routine, or merely because the case is one of fever, but only to meet certain definite indications. These are mainly evidences of weakness of the heart—frequent, weak, and fluttering pulse, and weakness or absence of the first sound of the heart. When, as is usually the case, the tongue is also dry, and the teeth and lips are covered and the mouth lined with sordes, the indications for the use of stimulants are unmistakable. The effects should be watched; when alcohol does good the pulse becomes less frequent, and of better strength and volume, and the temperature is usually lowered; an important indication also is that the odour of spirit is not detected in the breath. When very high temperature and other unfavourable prognostic symptoms set in very early, stimulants may be given without waiting for the conditions above-mentioned. Alcohol is again often required as an adjunct to the treatment of fever by the cold bath. The safest form of stimulant is brandy or whiskey; the quantity needed will vary greatly in different cases; in some 2 or 3 ounces in the twenty-four hours will be sufficient, in others 10 or 12 ounces may be required. It should be given in divided doses in, or immediately after, the milk or beef-tea.

It will be convenient to say here a word on the use of opium. Its employment in certain complications—tympanites, peritonitis with or without perforation, hæmorrhage, and excessive diarhœa—will be described later; the question now is whether it is well to give it for the relief of sleeplessness and restlessness. In the writer's opinion, when the restlessness is not so far allayed by cold or tepid sponging as to permit of sleep, it is of great advantage to the patient to give 10 or 15 minims of laudanum at night, or its equivalent in some other form. The writer has not found it to interfere with the digestion.

It is now almost universally recognised that it is not in the power of medicinal agencies to cut short an attack of fever, or indeed effectually to modify its course; no specific treatment, therefore, has to be described. It is true that the hypothesis of the bacteroid origin of typhoid fever has led to the employment of carbolic acid, of sulpho-carbolates, and of salicylic acid, and good results are said to have been obtained, but satisfactory evidence is still required. Every new line of treatment is pronounced to be successful for a time. In a large proportion of cases no medicine need be given from first to last, but effervescing salines are usually grateful; the mineral acids, at one time very largely employed, often seem in small doses to do good; and one or two grains of quinine may frequently be given with advantage. It should be understood that medicines are of less importance than food, and that they are not to be allowed to interfere with its regular administration. A gentle aperient at the outset is often useful, but it may be blamed for subsequent diarrhœa. At one time grey powder (3 or 4 grains) was given two or three times a day during the early part of the attack, and in watching cases so treated the writer's impression has been that the fever has been moderated. A single dose at the outset has seemed to him to do good. In Germany the treatment is often begun by administering 6 or 8 grains of calomel in two doses. The main use of pharmaceutical remedies in typhoid fever is in the treatment of certain emergencies, and of the various complications, and this will be for the most part described at the same time with the complications. An important drug, however, has not been mentioned, namely, digitalis. This has been employed in considerable doses for the purpose of forcing down the temperature, sometimes alone, but more commonly as an adjunct to quinine, and it has been said that it is not to be given for the purpose of strengthening the failing heart, or of reducing the frequency of the pulse. In the writer's experience it is of great value for these last-named purposes, given with ammonia or other stimulant, or with tonics.

There still remains to be discussed the employment of the cold or graduated bath. The great source of danger in typhoid fever is the prolonged high temperature, and it is to this, rather than to the fever poison or process, that are due the prostration of the nervous system, and the weakness of the heart which are the most frequent causes of death; to keep down, therefore, the febrile heat of the body is to diminish very greatly the danger attending this disease, and such is the object of the treatment by bathing. The cold-water treatment of fever was, as is well known, originated by Dr. James Currie, and practised with marked success by him and many other distinguished and trustworthy physicians. Notwithstanding results obviously good, it fell into disuse, till revived by Dr. Brand, of Stettin. Dr. Brand's method is to place the patient in water at a temperature of 65° or 70° Fah. whenever the temperature of the body, as taken in the rectum, reaches 102·2°, and to keep him there for ten, fifteen, or twenty-five minutes, until the heat is reduced 2°, or at any rate until he has been shivering for some minutes. Liebermeister takes 103° as the temperature which requires the bath, and this he does not make quite so cold, that is, 75° Fah., while he recommends ten minutes only as the period of immersion. The bath has to be repeated three, six, or eight times a day, as often indeed as the heat of the body rises to the point named; and it must be persevered with for two or three weeks or more, as may be required. A little brandy is given before or during the bath; and when the patient is taken out of the water, he is placed in bed, dried, covered up, but not too warmly, and kept at rest (*see* HYDROTHERAPEUTICS). In order that the full benefit may be obtained from this treatment, it must be begun early, in which case the temperature need never be allowed to reach an injurious height, and it is claimed that the intestinal lesions are also held in check. When thus carried out, it must be taken as established that the mortality of enteric fever is very greatly reduced by the bathing; Jürgensen's statistics show a reduction from 15·4 per cent. to 3·1; Liebermeister's from 27·3 to 8·2 (this observer, however, employing quinine largely); others show a still larger fall; and it may be safely estimated that in France and Germany the deaths have been diminished by at least one-half. No such results unfortunately are as yet forthcoming in England, but Dr. Cayley has shown that they are to be expected, and the writer's own experience is corroborative of his conclusions. Against the advantages of cold bathing are to be set off the difficulty of carrying it out, and the labour it involves; the prejudices of the public, and the dislike and dread of some patients; the facts that some cases may be protracted (which, by the way, might otherwise end fatally); and that relapse is certainly more frequent. These are good reasons for trying whether the same end may not be attained by other means; but unless we are successful in this, the duty of the medical attendant is to insist on the uncompromising employment of the cold bath. The graduated bath, in which the initial temperature of the water is 90° Fah., or, as the writer has found to answer the purpose equally well, 80°, is often more acceptable to patients, the water being cooled down rapidly to 70° or 65°. If the fever be high, and the nervous prostration great, conditions in which the shock of sudden cold is of great service, the cold water added to bring down the temperature may be poured over the patient's head. The cold wet pack and Thornton's ice-cap have been tried as alternatives to the bath, but without effects adequate to the requirements of the case. It has been hoped

again to prolong the effects of the bath, and so render frequent repetition unnecessary, by the administration of large doses of quinine or salicylic acid. Quinine, to keep down the temperature for any considerable time, must be given in large doses, 30 or 40 grains; and even this amount will, as a rule, produce no decided impression unless the way has been cleared by a bath. It is to be given, then, shortly after a bath in two or three equal portions within the space of about half-an-hour, and a little laudanum may be given with, or just before the quinine, to prevent vomiting. Very frequently the temperature remains depressed for twenty-four hours afterwards, sometimes even for a longer period. The patient often suffers from severe symptoms of cinchonism, but in view of the advantage obtained this need not be seriously regarded. Sometimes, however, violent and protracted vomiting is set up, which is an absolute bar to the further employment of quinine, except hypodermically. The neutral sulphate is the most convenient form for this purpose, and it is sufficiently soluble to be given in adequate doses, that is, of 5 or 6 grains. The writer's own experience tends to the conclusion that the frequent bathing has advantages over the combination of quinine with the bath, both as regards the safety and the comfort of the patient; though he has also seen cases in which the bath alone seemed inadequate, while with the aid of quinine the fever was kept down. He has twice seen severe tetanus produced by the bath and quinine, both cases, however, recovering. Salicylic acid and the salicylates have appeared to him to have a dangerously depressing effect. Of digitalis employed in large doses as an antipyretic, he has had no experience.

Without going so far as to say that Brand's rule should be obeyed absolutely, and in all cases, the writer is of opinion that many lives would be saved were cold-bathing at once put in practice, whenever a temperature of 103·5° or 104° Fahr. in the first few days shows that the attack is of more than average severity; and it is of the greatest importance that this should be done early, so that the pyrexia may never get the upper hand, and that the intestinal lesions may, if such a thing is possible, be modified. And no patient should be deprived of the chance which is afforded by the bath when, at any stage of the disease, life is threatened by hyperpyrexia or by consequences of high temperature, such as violent excitement, sleeplessness, restlessness, or nervous prostration. The only complications which render the bath inadmissible are hæmorrhage, peritonitis, and the advanced cardiac weakness and degeneration sometimes found late in the disease. Albuminuria or pulmonary affections do not constitute a bar to cold bathing. The writer has known albumen to disappear from the urine at once, and pulmonary congestion to clear up after a single bath.

**Treatment of Complications.**—We will now consider the treatment of the chief symptoms and complications. The most careful watch should be kept for complications at all stages of the fever, but especially after the end of the second week. A rise of temperature must always be taken to have some definite significance requiring explanation. With increased frequency of respiration, it may be the sole indication of the accession of pneumonia or pleurisy. A fall of temperature may give warning of hæmorrhage. Retention of urine, though uncommon in typhoid as compared with typhus fever, should always be borne in mind; and unusual restlessness should at once suggest an examination of the hypogastrium. The passage of a catheter has often put an end to sleeplessness and excitement. Bed-sores ought never to occur, and it will conduce to their prevention for the medical attendant to inspect the sacral region and other parts where they are liable to be produced.

*Hæmorrhage.*—In the treatment of hæmorrhage the first thing to be done is to arrest the peristaltic action of the bowels by a full dose of opium; and as an immediate effect is required, one of the liquid preparations should be given—the tincture or liquor, and the dose may be from 20 minims to a drachm. The bleeding vessel has to be closed by a clot, and peristaltic movements will tend to disturb this, while it must be remembered that the blood poured out is a continued provocative of movements on the part of the intestine. Direct astringents which depend on local action are useless; before they could travel the whole length of the small intestine, and reach the bleeding point, they would be neutralised by combining with the intestinal contents. Physiological hæmostatics may be of more service. Alternate doses every hour or every two hours, of liquor ergotæ, 3ss to 3j, and of turpentine ♏x–xv have seemed to the writer to have most effect. Acetate of lead and opium or morphia, sulphuric acid and decoction of logwood, tannic acid, and all the known styptics have been recommended. An important adjunct—probably more effectual than any internal remedy except opium, is an ice-bag over the region of the cæcum; this at the same time quiets peristalsis, and contracts the vessels.

Stimulants must be given if the patient is in danger of dying from syncope, but it must be borne in mind that fainting gives time for the vessels to close, and until the bleeding has stopped, this condition must not be too diligently averted. We must, in fact, sail as close to the wind as is consistent with safety. The same considerations apply to the administration of food; very little, if any, should be given by the mouth for twenty-four hours, nourishment being supplied by small nutrient enemata.

*Perforation.*—The only treatment likely to be of any service is the administration of large doses (3j or more) of laudanum or liquor opii or an equivalent of morphia, either hypodermically or by the mouth. This has saved life in a few cases of undoubted perforation, but in the immense majority of cases a fatal termination speedily ensues.

*Peritonitis.*—Here, again, opium in repeated moderate doses is the most useful remedy; with poultices applied over the abdomen.

*Tympanites.*—Once more the remedy is opium, which should be given in pill three or four times a day when the distension is late and gradual; in very large doses of some liquid preparation when it is sudden. Charcoal has been recom-

mended, but in the writer's experience it has rarely been other than hurtful.

*Diarrhœa.*—As long as the stools do not exceed three a day, or while they do not appear to distress or exhaust the patient, nothing special need be done to check the diarrhœa. It must always be borne in mind that beef-tea or other strong flesh-juices may excite diarrhœa; undigested curds of milk may have the same effect. As soon as undue frequency in the action of the bowels is observed, any possible cause in the diet should be eliminated; this failing, the best remedy is an opiate enema, 20 or 30 drops of laudanum in 2 ounces of thin starch. In most cases two or three enemata will arrest the diarrhœa; should this not happen astringents must be given by the mouth—acetate of lead and opium or morphia, sulphuric acid, laudanum, logwood, or tannic acid.

*Constipation.*—This, whether intercurrent when there has been diarrhœa, or present throughout the fever, is a perplexing symptom. It is best relieved by enemata given every other day, but sometimes these are insufficient: a teaspoonful of castor oil may then be given, care being taken that any accumulation in the rectum which might give rise to difficulty is previously removed by enema.

*Albuminuria.*—Nephritis must be treated by poultices and dry cupping over the kidneys. Albuminuria due to alteration of the blood requires no special treatment, and it is not a bar to cold bathing, but on the contrary may be among the symptoms calling for it. The disappearance of albumen from the urine, which is sometimes observed when the temperature has been reduced by bathing, seems to show that the blood-change is due to the pyrexia, and not to the poison.

*Pneumonia.*—When pneumonia sets in, stimulants are generally required, and the patient will derive benefit from bark or quinine, which may be given in the form of the ammoniated tincture. Turpentine in small doses, or the stimulant balsams, will often be found useful. Turpentine stupes are generally better than poultices.

*Thrombosis.*—Elevation of the leg on soft cushions, warmth, and gentle support by means of a flannel bandage, will be the treatment required.

W. H. Broadbent.

**TYPHOID STATE** (*τῦφος*, stupor).—Synon.: Fr. *État typhoïde; État adynamique*; Ger. *Typhose Erscheinungen.*

Definition.—A condition which may arise in the course of any febrile disorder, when the approach of death is gradual, and the rise of temperature either excessive or long-continued. The typhoid state is, however, most frequent in typhus, enteric, yellow fever, and pernicious malarial fevers; and in such cases the tendency is often evident from the very beginning of the attack.

Ætiology.—It is unwise to attempt to attribute all these different symptoms to one single cause. The chief primary cause may be the injurious influence of a high internal temperature upon the central nervous organs, but this same temperature acts directly also upon the parenchyma of glandular organs, and upon the muscular fibre, both of the heart (Stokes), and of the voluntary muscles (Zenker); and the disorder of the nervous centres must be greatly increased by, if not sometimes directly due to, the changes in the composition of the blood, and in the forces of the circulation.

Description.—The symptoms of the typhoid state relate chiefly to the nervous system, and indicate depression, not excitement. There is low muttering delirium, passing into stupor, with little or no true sleep (*coma-vigil*); with derangement of the senses, and hallucinations of sight and hearing. The urine and fæces are passed unconsciously, or there may be retention of urine. The sensibility of the skin is greatly impaired: flies may creep unnoticed even over the eyelids. General muscular weakness is marked, the patient lying on his back, sunk down in the bed. The lips and gums are covered with sordes, and the tongue is dry and black. *Subsultus tendinum* is present. The pulse is frequently running, so that it is difficult to distinguish and count the beats; small and weak; sometimes irregular and easily affected by slight causes, for instance, failing distinctly during inspiration. The heart's impulse is greatly weakened; the first sound almost or quite lost at the apex. The skin is dry, if, as is often the case, the temperature is high, 104–5° Fahr. or upwards; or it is bathed in clammy sweats, which rarely prevail at one time over the entire surface. There is lividity of, or even ecchymoses on, the under aspect of the trunk and limbs; and in the exanthematous fevers the eruption becomes petechial. The breathing is hurried, shallow, and towards the close frequently assumes the type known as Cheyne-Stokes respiration.

Prognosis.—The prognosis of the typhoid state is always grave, but in fevers which run a definite course recovery may take place, even when the condition is fully developed, if it be so only at or near the crisis.

Treatment.—The treatment consists in the free use of stimulants. Of these brandy is the best, and may be given in doses of half an ounce every half-hour or hour; but the quantity must be determined, not by measure, but by the effects upon the patient. If no improvement follows its exhibition by the mouth, frequently repeated rectal injections of brandy with egg or strong beef-tea ought to be tried. Musk, in doses of one to three grains, has been recommended, but the writer does not attach any value to this drug in these cases. The subcutaneous injection of five to fifteen minims of ether is often so successful in increasing the vigour of the heart's action, that it well deserves a trial here, too, if other means prove ineffectual. If the temperature is excessive, the cold or tepid bath, or the cold pack, should be used; but immediately before or during the application of external cold, half an ounce of brandy at least should always be given. The salutary effects of cold are maintained and increased by full doses of quinine, such as five or ten grains of the sulphate every hour, until twenty or thirty grains have been taken. The writer cannot advise the use of salicylic acid or its salts in the typhoid state. External stimulating applications are not without value, for example, vesication by blistering fluid, or by strong liquor ammoniæ to the shaven scalp,

when nervous symptoms predominate, or a flying blister to the præcordia when the heart's action is seriously impaired. Throughout the typhoid state the patient's strength must be husbanded as carefully as possible; and the great object of the nursing should be to save him from the necessity of any mental or muscular effort whatever. JAMES ANDREW.

**TYPHUS FEVER** (*τῦφος*, stupor).—SYNON.: Fr. *Typhus*; Ger. *Typhus*; *Flecktyphus*.

DEFINITION.—A contagious febrile disease, marked by a peculiar dark rash, with considerable cerebral depression, and lasting about three weeks.

ÆTIOLOGY AND PATHOLOGY.—Typhus is a disease of temperate and cold climates, and appears from time to time as an epidemic in our towns and larger villages. Purely rural parts of the country seem to be in a great measure exempt from it. Sometimes it spreads as an epidemic over a large part of the country, either affecting many towns simultaneously, or breaking out in them in rapid succession; but often it attacks only a single town, or a few towns at considerable distances from each other, leaving others between them untouched. When a serious epidemic of typhus occurs in a town, it usually lasts for a considerable period, often for the better part of three years; not, however, of the same severity throughout, but increasing or diminishing with the fall or rise of the temperature. Thus the greatest number of cases occur during winter, and the smallest number during summer; and changes of temperature are followed (not closely, but in a sort of rough way) by changes in the numbers attacked; whilst the ratio of mortality remains substantially the same from the beginning to the end of the outbreak. The larger number of cases is usually made up of females and young persons, and this is particularly noticeable at the commencement of an epidemic; but the heaviest rate of mortality is among the adult males.

Like the other exanthems, typhus usually attacks an individual but once; although it must be admitted that this is not invariable, for some persons seem liable to catch the disease as often as they are exposed to contagion. Such cases, however, must be considered as exceptional; while many cases of so-called second attacks are not real, and may be otherwise accounted for. When typhus enters a household, and sweeps over the members of a family, it often happens that one or two of them, instead of presenting the regular symptoms of the disease, are affected merely by a slight febrile attack, lasting for a short time. Such cases are usually spoken of as having had 'the fever' along with the rest of the family; and if they are at some future period affected with typhus, are set down as having undergone a second attack. This is obviously a mistake; but, even separating these cases, there remain a certain number—not very large, it is true—where a second or even a third attack has occurred in the same individual.

Although not so extremely contagious as scarlatina or small-pox, yet typhus is undoubtedly propagated by contagion.[1] The area of contagion is, however, limited to a comparatively small space around the patient. As the breath has a peculiar, heavy smell—noticeable, however, only within a short distance (a foot or two) of the patient's face, it is not unlikely that the contagion is contained in the exhalations from the lungs. Whether this be the case or no, the contagion is certainly propagated through the air; it is not capable of being carried by the clothes or by the excreta; and its free dilution with abundance of fresh air destroys entirely its noxious influence. Hence, if the patient can be isolated in a large, well-ventilated apartment, there need be no difficulty in preventing the spread of the disease to others of a family; and the facility of thus limiting typhus is in marked contrast with the great difficulty of doing so in such diseases as scarlatina or small-pox. Unfortunately, it is only among the wealthier classes of society that this mode of checking the spread of typhus can effectually be adopted, and hence the rapidity with which it sweeps over the poorer and working classes, when once an epidemic has fairly broken out.

If we examine carefully the details of any epidemic, we find that it is in the most crowded parts of a town that it always begins, and that in a given street it is in the most crowded houses that it appears; that if at the outset the population be quickly thinned by the removal of several of the inmates from a house or group of houses, the disease is often checked; but that it readily breaks out again if the crowding be renewed. Hence the primary cause of typhus is, in all probability, to be ascribed to the exhalations from a closely crowded population, pent up in small rooms, and prevented from free access of fresh air by the obstacle of houses closely packed together. This view of its origin readily explains its greater prevalence in winter, and its attacking females and young persons in greater numbers than adult males in a working population; for it is in winter that houses are, for the sake of warmth, most crowded and most badly ventilated; and the females and younger members of a family are those most continuously exposed to any injurious influences which the home may possess. This also explains the comparative immunity from the disease of purely rural districts, and the small extent to which the upper classes, and those inhabiting the open sparsely-built suburbs of our towns, are affected by it. It may be objected that, were this the cause, the disease ought to be an endemic constantly present in all our towns; but if it rarely attacks an individual more than once, it must evidently die out after a short time from lack of materials, and would not reappear for some years, or until another generation has grown up liable to its attacks. According to this view the bulk of typhus cases should be comparatively young; and this is found really to hold good, the great majority of those attacked being between the ages of ten and thirty.

It would seem as if in some epidemics typhus were connected with an under-fed or half-starved

[1] Examination of cases where accurate data were attainable shows the period of incubation to be about a week. This may be shortened, or somewhat lengthened; but statements extending it over several weeks are to be received with much hesitation.

condition of the working classes; but this is by no means an essential condition. When famine exists, it will, for obvious reasons, carry with it the condition of overcrowding; and it will have a material effect on the results of an epidemic, inasmuch as it will render individuals less able to resist the disease, and so will not only facilitate its spread, but will increase the ratio of mortality. But even when the working classes are in full employment and well-fed, typhus from time to time breaks out among them, and the only condition uniformly observable is that of overcrowding.

Anatomical Characters.—Of the pathology of typhus little is known. *Post-mortem* examination shows that the blood is dark-coloured, usually fluid, or presenting soft and very loose coagula in the cavities of the heart and the larger vessels. This appearance, however, depending apparently on a deficiency in the fibrin of the blood, is not peculiar to typhus, but is common to it with most zymotic diseases. No intestinal affection is seen, such as is present in enteric fever. The vessels of the brain are usually loaded, but there is no effusion, and no trace of any deposit, or of anything approaching to inflammatory change. The only decided lesion to be seen is in the cervical sympathetic, the ganglia of which are somewhat enlarged by a granular amorphous deposit. This, which extends more or less to all the cervical ganglia, is best seen in cases dying during the second week; when death occurs later, it is much less noticeable, or may be wanting altogether. From this it may be assumed that the condition passes away with the fading of the characteristic symptoms of the disease. Sometimes the deposit is limited to the ganglia of one side, and in this case it may be connected with a symptom occasionally observable—a difference between the temperature of the two axillæ. If this lesion be regarded as an essential feature of the disease, it would certainly afford an explanation of the localisation of the symptoms, of the disturbed function of the brain, and of the weak action of the heart; but even admitting this, there is still wanting an explanation of the nature of the infection, and of the reason why its force should be spent on these organs alone. It has been stated that there occurs a definite structural change in the heart itself, to which may be due the alteration in the heart's sounds; but this the writer has been unable to verify, although he has had the opportunity of looking for it in a large number of *post-mortem* examinations. The texture of the heart certainly is soft and flabby, with but little cadaveric rigidity; but the same is observed in the whole muscular system.

Symptoms.—Typhus frequently begins in a well-marked way with a rigor, or with headache and sickness—more commonly the former; but very often nothing definite marks the exact time of commencement, and then the symptoms come on slowly, and gradually increase in intensity. The symptoms may be shortly summarised as follows:—Heaviness and listlessness, with a certain amount of confusion of ideas, and a difficulty or impossibility of fixing the mind steadily or continuously on any subject; dulness of all the senses, with a heavy stupid look in the face; dark-coloured rash, in small dusky-brownish spots, especially noticeable over the abdomen, and not fading till convalescence begins; heat of skin, and rise of temperature; quick, weak, frequent pulse; white or brown dry furred tongue; thirst; constipation; and considerable muscular prostration.

The disease runs its course in three weeks, which may be divided into a week of onset, a week of danger, and a week of convalescence. During the first two or three days of the attack the symptoms may not be very urgent; the patient may be going about, and even at his usual avocations, although he feels that these are performed with difficulty, especially if they involve any mental exertion. Towards the end of the first week the symptoms become all well-marked; the characteristic rash makes its appearance; and the patient is now confined to bed. During the second week the symptoms increase rapidly in intensity, especially the muscular prostration, the rapidity of the pulse, and the confusion of ideas; and these steadily progress until the fourteenth day, when the disease appears to have attained its height. With the third week the tongue begins to clean, and the pulse and temperature to fall; the rash quickly disappears; the expression of the face changes; the mind becomes clear; and the symptoms gradually disappear. By the end of the third week the attack may be said to have terminated, but there is often much weakness left, and it may be some time before the strength is completely re-established. Usually a week or ten days will suffice for this; but after a severe attack, or in a patient previously debilitated, several weeks may be required.

The more important symptoms may now be described somewhat in detail:—

*Nervous System.*—The best-marked of the local symptoms are those referring to the brain. From the very commencement there is a feeling of dulness and heaviness, with an indisposition to any mental exertion; a dull heavy look about the face; a vacant expression in the eyes; a slowness in answering questions, and a partial confusion of ideas; the patient lying as if in a half-dreamy condition, and paying little attention to anything around him. As the disease progresses, these symptoms become more and more marked. Even in comparatively mild cases there is often a little muttering, or a few incoherent words are uttered from time to time; but the patient is aware that he is talking nonsense, and readily admits it though unable to control it. In severer cases, again, the delirium is very decided; the patient lies perfectly indifferent, muttering incoherently from time to time; and replies scarcely, or not at all, to questions, although he is not absolutely unconscious, as he will protrude the tongue if sharply told to do so. Not unfrequently patients afterwards ask whether in this delirium they have not spoken of things they would wish concealed, but on this point they may be safely reassured; nothing like a continuous or connected train of thought passes through the mind—all is disjointed and fragmentary; and accordingly the words uttered, even if pieced together, are entirely meaningless. Along with this confusion of ideas goes a

dulness of all the senses; taste and smell are entirely lost; and although, from the great thirst, there is a craving for drinks, yet all are accepted alike, and the feeling of relief which they give is unconnected with their taste, which is not really perceived. Hearing is considerably dulled, a certain amount of deafness being a very common symptom; so that it is necessary to speak to the patient in a distinct tone of voice, and tolerably close, otherwise he will fail to catch what is said to him. Vision is seemingly also a little impaired, although not to so marked an extent as the other senses. Even ordinary tactile sensation is dull, and the impressions derived from it are often confused.

*Muscular System.*—Muscular prostration is, even from the first, a prominent symptom. At the very onset, and while the patient may still be going about, he complains of a feeling of weakness; the gait is often somewhat unsteady; and after he is confined to bed this weakness becomes more marked. In serious cases he lies supine, turning himself rarely, or in bad cases not at all. If turned on the side he soon slides round again upon the back; the limbs are allowed to lie slack in almost any position; when the hand is raised it is tremulous; so also is the tongue when protruded—the very protrusion is accomplished with difficulty, and the point is pushed scarcely, if at all, beyond the lips. In bad cases, subsultus is occasionally present. This muscular prostration, in conjunction with the dulness of sensation, is doubtless the cause of the constipation so usually present; and the occasional occurrence of retention of urine is to be explained in the same way, by inattention to the sensation, and by disinclination to make even the slight exertion requisite for emptying the bladder.

*Circulatory System.*—The pulse is always weak, and commonly frequent. In mild cases it does not usually rise over 100; in more serious ones it rises to 120; and in bad cases to 140, or even more. The character is, however, of more importance than its frequency; for while a very frequent pulse always indicates danger, a comparatively infrequent pulse, if it be weak and jerking in character, may be equally serious, and hence it occasionally happens that cases prove fatal where the pulse has not risen above 100. In some cases the pulse is markedly dicrotic during the second week, and this especially happens if there be any pre-existing lesion of the heart.

A good deal of stress has been laid by some observers upon the action of the heart as indicated by the stethoscope. In all serious cases, the heart's sounds are much fainter than usual, and one or other, more commonly the first sound, may become so faint as to be inaudible. This condition is generally most readily made out by placing the stethoscope over the apex of the heart, when the altered character or absence of the first sound is at once noticeable. Sometimes the second sound, as heard over the base of the heart, is lost; but this is unusual. The alteration or absence of the first sound has no necessary connection with the rapidity of the heart's action, being as often present when the number of beats is under 100, as it is when the number is over that figure; but the symptom marks the weakness of the heart's action, and is always associated with a weak pulse, and a considerable amount of cerebral disturbance.

*Digestive System.*—With great thirst, there is a dry tongue, which is first white and finally brown. The brown colour is at first in the form of two broad bands, one on each side, the centre and edges remaining white. In bad cases the whole tongue becomes brown, often cracked and bloody; and the same dry, cracked, and bloody appearance may extend to the lips, the gums and teeth becoming crusted with sordes. When the week of convalescence begins, the tongue at once commences to clean at the edges; then becomes moist; and finally the fur clears slowly off. It generally requires the whole week of convalescence to accomplish this.

*Eruption.*—The rash in typhus fever is very characteristic, and is almost invariably present, although the amount varies much. In an epidemic stray cases from time to time occur where the rash is wanting, and the symptoms are otherwise mild; but it may be doubted whether these are cases of genuine typhus; at any rate it is amongst cases of this kind that second attacks are chiefly found. The rash appears in the form of small, roundish, dusky, or brown-red spots; not raised at all above the surface; generally very distinct, but sometimes indistinct, as if dimly seen through a hazy medium. It is always most marked about the upper, or middle and upper parts of the abdomen; and it may be limited to a few spots there. If more extensive, it is scattered over all the fore part of the abdomen, and over the lower and central parts of the chest. It sometimes extends to the limbs, and is then found over the fore part of the thighs and arms; but this is by no means very common.

The rash shows itself during the latter half of the first week, most commonly about the fourth or fifth day; but sometimes its appearance is delayed till the early part of the second week. The spots, if few, appear nearly simultaneously; but if numerous may come out in successive crops, extending over two or three days. Once out they undergo no further change, except a gradual deepening or darkening in colour. They remain out till the commencement of the week of convalescence, and then they rapidly disappear. In bad cases petechiæ may also be present, and passive hæmorrhage in any situation.

Complications.—The only complication of common occurrence in typhus is a low form of pneumonia. This seems to begin chiefly by hypostatic congestion; it occurs first at the back of the lungs, usually affecting both more or less; and seems to be due mainly to position. The patient, in severe cases, lies nearly continuously on the back, and this posture, along with the weak and languid state of the circulation, permits a gorging of the posterior part of the lungs. Probably in all severe cases this gorging is present to a certain extent—at least, it is a very common *post-mortem* appearance; but in some cases the condition goes a step farther, and drifts into pneumonia. The disease thus produced rarely runs the course, or presents the symptoms, of acute pneumonia; it scarcely goes beyond the first stage, presenting on *post-mortem* examination a very dark appearance, as if of great venous

congestion, with a certain amount of œdema and solidification; but usually nothing of red or grey hepatisation. When it does appear, it is commonly towards the end of the second week—the period when the causes above-mentioned are in operation to the greatest extent, and if it involve much of the lung, it proves fatal in a few days. Most of the cases that are fatal during the third week are cut off by this complication. Occasionally, though rarely, the attack of pneumonia continues longer, and causes death in the fourth week, that is, after the attack of typhus is over; but in such cases the symptoms and *post-mortem* appearances approach more to those of ordinary pneumonia. The signs of this complication are cough, with little or no sputa; more or less oppression of the breathing; and small crepitation, most noticeable always at the back of the chest. This last is to be accepted as the reliable indication, for the patient, as a rule, makes little or no complaint; and, therefore, if cough, even to a small extent, be present, the stethoscope should be used to determine the state of the lung. It sometimes shows itself after the week of convalescence has begun; and if at that time the tongue becomes again dry after it has begun to clean, or if the pulse begins again to rise, the chest should be examined, even though no cough be spoken of, for the arrest of convalescence is often due to the commencement of this affection of the lung.

Diagnosis.—Typhus as above defined is readily recognised. It is distinguished from typhoid or enteric fever, by the character of the eruption, which in typhus is in dusky brown-red *spots*, remaining out till convalescence, whilst in enteric it is in bright rose-red *points* coming out and fading in successive crops; by the presence of the head-symptoms; and by the absence of sickness, vomiting, diarrhœa, and abdominal tenderness. From meningitis, or any acute cerebral affection, it is distinguished by the absence of excitement or of acute pain; by the character of the delirium; by the dry-coated, usually brown, tongue; by the weak pulse; by the eruption; and by the muscular prostration. From any chronic cerebral affection it is distinguished by the presence of fever, in addition to the above characters.

Mortality and Prognosis.—The ratio of mortality from typhus varies somewhat in different places and in different epidemics; but the average may be stated as from 10 or 12 to 18 or 20 per cent. This, however, applies only to the total mortality extending over a large number of cases. If this mortality be analysed, it is found that it varies directly with the age. In the young the mortality is small, in the middle-aged it is considerably increased, and after middle life it is very high. This may be expressed in figures thus:—under 25 years of age, mortality about 5 per cent.; from 25 to 50 years of age, mortality about 25 per cent.; over 50 years of age, mortality about 50 per cent.

In adults the rate of mortality is usually higher in males than in females,[1] a difference, however, which does not hold good in the case of young persons or children. This is probably due to the circumstance that when females or young persons are attacked, they are at once put under treatment, or at least allowed to rest; whilst adult males, especially heads of families, struggle on for some time after the disease has begun, being unwilling, for the sake of those dependent on them, to give up work until the advance of the disease compels them to do so; and by this means the strength is exhausted early in the disease, and the chance of recovery materially impaired. In the better classes of society, the ratio of mortality is often higher than among the working classes.

The bulk of the deaths occur in the second week, and most commonly in the latter half of it—from the tenth to the twelfth day inclusive being the most fatal period. Death very rarely occurs during the first week, although in bad cases it may occur early in the second week. It sometimes happens that death occurs in the third week in uncomplicated cases, as if there had not been sufficient strength left to rally after the brunt of the attack was over; but this is unusual. When death occurs in the third week, it is commonly due to pneumonia.

The prognosis in typhus depends on the severity of the symptoms, especially of the brain-symptoms, and of the muscular prostration. If there be much delirium or muttering incoherence, the prognosis is bad, especially if, as is commonly the case, this be associated with a quick pulse (130 or over), such cases being usually fatal. On the other hand, if the pulse be not over 100, if there be little confusion of ideas, and if plenty of nourishment be taken, the case is a mild one, and will readily recover. The indications from the rapidity of the pulse, and from the cerebral symptoms, do not, however, invariably coincide; and in that case the latter are the more to be regarded. Thus, if there be much incoherence, with indifference and prostration, and but little nourishment be taken, even though the pulse may not be over 100, the prognosis is bad; whilst, if there be little confusion, and plenty of nourishment be taken, even though the pulse be 120, the prognosis, though guarded, is not unfavourable. The character of the pulse, as to weakness or otherwise, is of more value than the mere rapidity. If the pulse rise much early in the attack, it is indicative of danger. The amount of the rash seems to be of little moment, and is no guide to the severity of the attack. If the tongue, after beginning to clean, become again furred, or if the pulse rise again after having fallen, it is significant of danger, and points to the occurrence of some complication, most commonly pneumonia.

The stethoscopic character of the cardiac sounds (impairment or absence of the first sound) may be associated with weak pulse and cerebral disturbance, as a measure of the amount of danger. It implies great weakness of the heart's action, corresponding so far to the muscular prostration elsewhere noticeable, only to a greater extent; and, as occurring in so important an organ, indicating always the presence of danger.

Treatment.—*Preventive.*—When typhus breaks out in a family, the first step to be taken is to endeavour to prevent its spread. For this purpose the

[1] In pregnant females abortion often occurs, and such cases are usually fatal.

patient should be isolated, and placed in a large well-aired room, with a single attendant as nurse; and as little communication as possible must be allowed with the rest of the inmates of the house. Amongst the better classes of society, this is easily effected; but amongst the working classes an arrangement of this kind is usually impracticable, and then the best course is the removal of the patient to a suitable hospital. This removal should be effected at once, not only because the risk of the disease spreading is lessened by thus removing a source of infection; but also because removal late in the disease is always injurious to the patient, and often dangerous. In this removal the patient should always be carried, and not allowed to walk, even should he fancy himself able to do so.

*Curative.*—Many attempts have been made, by very various means, to cut short the disease; but of these it may be said that all have failed. The principle of treatment is therefore to keep up and economise the strength by every means, until the fortnight shall have passed, when convalescence will occur of itself. For this purpose constant and careful nursing is essential. The patient should be kept absolutely in bed, and not allowed to rise, even in the early days of the attack, when he may fancy himself able to do so; he should be fed at short intervals with liquid nourishment, especially milk and strong beef-tea, or strong soups, and these should be given to as great an extent as the patient can be induced to take them. The thirst should be relieved by diluents of any kind, such as plain water, barley water, effervescing drinks, or diluted lemon-juice. Taste being nearly gone, the patient will take them indiscriminately; but it should be remembered that in serious cases he will not trouble to ask for them; they should, therefore, be offered very frequently, and the nourishment should also be pressed upon him. The tendency to constipation is easily obviated by an occasional dose of castor oil. Care should be taken that the bladder is regularly emptied; not that there is any real retention, for the patient can readily empty it if he makes the effort. Usually all that is required is to tell him to do so; but sometimes, though rarely, it may be requisite to pass the catheter. Absolute quiet should be secured; the patient should not be spoken to more than is absolutely necessary; no conversation should be permitted; if he talks in a rambling way, as is often the case, he should not be answered. For sleeplessness or delirium, the best remedies, besides quiet, are darkening the room, and applying cold wet cloths steadily to the head. Cold applications frequently soothe the delirium and procure sleep. Opium and sedatives are ill-borne, and should never be had recourse to. The use of stimulants has been much debated; but there can be little doubt that their judicious use in moderate quantity is often very advantageous. They ought not, however, to be used indiscriminately, nor should they be employed early in the disease, but should be kept, as it were, in reserve, to push through an emergency. The best guides to their employment are the rapidity, and especially the strength, of the pulse; the extent of the muscular prostration; and the quantity of nourishment taken. If the latter be taken in fair quantity, and the weakness be not very great, the case will recover without the use of stimulants, and then they are better omitted. Recourse should not be had to them sooner than is absolutely necessary—certainly not during the first week if it can at all be avoided; and their use need not be prolonged far into the third week, for as soon as the appetite begins to return, reliance should be placed upon feeding, and stimulants should be laid aside. The quantity administered need not be large; four to six or eight ounces of wine, in small quantities at a time, in the twenty-four hours—a little more, with perhaps a small quantity of brandy added, in bad cases—will procure all the advantage obtainable; large doses tend to increase the head-symptoms, and do harm. The best indication of their doing good is the falling of the pulse. Attention should be given to the position of the patient, especially in view of the possible occurrence of pneumonia, or occasionally, in spare or emaciated individuals, of bed-sores. To avoid this, the supine position, which the patient always assumes in serious cases, should from time to time be altered, and he should be occasionally turned on one or other side. He will not lie long thus, but will gradually slip round again on to the back; but the change of position, even for a short time, is useful. If pneumonia occur, ipecacuanha or similar remedies in small doses should be had recourse to, along with stimulants. Cold sponging, especially of the face and hands, when the skin feels hot, is extremely agreeable and soothing to the patient.

R. Beveridge.

**TYROSIN.**—Tyrosin ($C^{18}H^{11}NO^6$) is always found in conjunction with leucin. It is never found in healthy livers (Kühne), but is perhaps present in small quantities in the spleen and pancreas. It is found in the liver and urine of acute yellow atrophy, and said to be present in the urine of typhoid fever and variola. The significance of tyrosin in the urine is uncertain. Under the microscope tyrosin is seen as fine colourless needles, but this appearance must never be trusted without chemical tests. Its mode of preparation is the same as that of leucin; but the residue of this, insoluble in boiling alcohol, must be dissolved in boiling water, and set aside to cool and crystallise. If to a solution of tyrosin a few drops of nitrate of mercury be added, and the whole boiled, the fluid becomes a rosy red, and throws down a red precipitate (Hoffmann's test). *See* Leucin; Jaundice; and Liver, Atrophy of, Acute Yellow.

J. Wickham Legg.

# U

**ULCER and ULCERATION** (ἕλκος, *Ulcus*, a sore).—Synon.: Sore; Fr. *Ulcère*; Ger. *Geschwür*.

Definition.—A solution of continuity on an epithelial or endothelial surface, secreting pus.

Ætiology.—A breach of surface may arise from external causes, such as a cut or laceration, pressure, destruction produced by an escharotic, a burn, or a bruise; or, on the other hand, it may result from changes commencing within the tissues themselves. These might be acute inflammation, giving rise to pus; chronic inflammation, giving rise to thickening of the fibrous tissue, with strangulation of the blood-vessels passing through it to the surface; or defective nutrition of the skin and subcutaneous tissues, as seen in senile subjects.

Anatomical Characters.—The parts of a healing ulcer are—the *surface*; the thin blue epidermic *pellicle*; the *edges*; the *surroundings*; the *discharge*. When an ulcer departs from the healing type, every possible variety of appearance occurs in the surface, edges, surroundings, discharge, and in the character and intensity of the accompanying pain.

When a section of an ulcer is examined microscopically, the following parts are made out:—a layer of pus on the surface; projecting up into the pus, fine points consisting of loops of blood-vessels, coated over with living white corpuscles, constituting granulations; beneath this, a zone of thickened inflammatory tissue, consisting mainly of fine fibrous tissues; and underneath this again, a zone of hyperæmia, where the blood-capillaries are very numerous, and the white blood-corpuscles are in excess. Beyond this zone healthy tissues are met with.

Should the whole of the affected part be seen on a perpendicular section, it would appear depressed in the centre, and each zone, from the surface downwards, would appear as an arc of a greater circle than the previous. Should the ulcer be other than healthy, the same parts would be met with, but each part would be modified according to the cause and character of the ulcer.

The history of the commencement of an ulcer will evidently vary, according as it originates (1) from *external*, or (2) from *internal* causes.

1. When *a wound* does not heal by primary union, by scabbing, or by first intention, it begins in twenty-four hours to show signs of active hyperæmia. The surface exudes first serum, then white blood-corpuscles, fibrin, and albuminous matters; the surroundings become congested and swollen; granulations appear in the bottom of the wound; and an ulcer is thus established.

2. When the changes commence *within* the tissues, they depend upon some local irritation, causing a determination of blood to the part. The irritation may be a varicose vein, a foreign body, a gumma, a strumous gland, or a scirrhus tumour. The blood-vessels at first exude serum, which infiltrates the neighbouring tissues, causing them to swell. White blood-corpuscles and fibrin after a time escape from the blood through the capillary walls, and the irritated spot becomes permeated by an embryonic connective tissue. The tissue thus formed passes, as the result of chronic irritation, to a higher state of development, becoming fine fibrous tissue, and having a tendency to shrink or contract upon the structures passing through it. The consequences of such a change as this in any part are, first, an increased activity of its normal functions; and, secondly, a cessation of its functions, and destruction of the tissue from the cutting off of its nutrition.

A section of the part in this condition would show the irritating spot in the centre, then a zone of indurated fibrous tissue, and around all a zone of hyperæmia. When the skin becomes involved it changes colour, the epidermis is shed rapidly, serum oozes out through cracks and fissures, and finally may collect on the surface to form a scab. When the scab falls off, a raw surface, consisting of the papillary layer of the skin, is seen, and from this a discharge flows away, becoming thicker and more purulent. The surface is now an open sore, secreting matter, and exists as an ulcer.

Pathology.—**Ulceration.**—The ulcerative process is so intimately associated with inflammation, suppuration, gangrene, phagedæna, granulation, and cicatrisation, that it is impossible to detach it from any one of these, and call it a separate definite process. Few writers agree in their descriptions of the extent of the process, some looking upon the ulcerative process as implying destruction of the tissues only; others, as signifying both destruction and repair. In its widest sense, the ulcerative process is the process whereby ulcers are formed, spread, arrested, maintained, and healed. The actual formation of an ulcer has been discussed; and when the ulcer is once established, the ulcerative process is seen to be a liquefaction and dissolution of the edges, and the formation of granulations and discharge. This process goes on from the beginning to the end of the history of an ulcer, so that it is impossible to say that it ends before healing takes place.

In the immediate neighbourhood of any ulcer, vascular changes take place, which have to be followed closely before the ulcerative process can be understood aright. In the first place, the capillaries in the neighbourhood of the irritated spot are in a state of tension, from increased blood-pressure, and they tend to relieve themselves by the transudation, first, of serum, and then of white blood-corpuscles and fibrin. These products behave differently, according as they escape into the *surrounding tissues*, or reach the *surface*.

(*a*) When the cells and fibrin escape into the *surrounding tissues*, they infiltrate the immediate neighbourhood of the ulcer, and produce swelling and blocking up of the tissues, and beyond that an area of increased nutrition, caused by the determination of blood. The pressure on the blood-vessels leads to interference with the circulation, and as a consequence, to a deficiency of the nutrition of the surrounding tissues. The cellular elements of these tissues swell, undergo degeneration, liquefy and are absorbed, or remain in the tissues. According to the intensity of the irritation, and the condition of the patient, so the area of infiltration and of liquefaction extends, and the degenerative process continues; or, on the other hand, along with the infiltration, induration occurs, and stays the processes of destruction. The arrest of the extension of infiltration, by the formation of a barrier of firm, fibrous, indurated tissue, is necessary before repair sufficient to heal the ulcer is induced.

(*b*) The portion of the transudation that reaches the *surface* consists of two parts. The part for which sufficient nutrition cannot be obtained flows away as pus, whilst the part that is retained in close proximity to the blood-vessels becomes formed into a layer of embryonic connective tissue. This layer, as the irritation declines in intensity, increases in thickness, becomes vascularised, and rises into small protuberances constituting granulations. The vascularisation of the embryonic connective tissue keeps pace with the continued addition of new cells on the surface, and so the reparative action is kept going. The deeper layer of first-formed cells now become spindle-shaped, with their long axis parallel to the blood-vessels. Along with the blood-vessels, lymphatics and sympathetic nerves find their way into the granulations. The spindle-shaped cells now form a denser tissue and shrink, and, as a consequence, the granulations diminish in size; the purulent secretion grows more scanty; and by-and-by the whole surface is involved in cicatricial tissue, and glossed over by an epithelial pellicle (*see* CICATRIZATION). The details of this process will vary according as the destructive or the reparative process predominates; the predominance of the former will cause ulcers to spread, forming inflamed and phagedænic ulcers; whilst the predominance of the latter will cause ulcers to heal, or when in excess to form 'proud flesh' or weak ulcers.

That an ulcer heals by the building up of new tissue is much to be doubted. The ulcer comes to the same level as the surroundings, not so much, if at all, by the growth of its granulations, as by the subsidence of the swelling and induration in the edges and surroundings themselves. Before it can heal these must be restored to a normal state, and it is only when this takes place, and the same level is reached, that the epidermis advances and glosses over the fibrous tissues of the cicatrix.

VARIETIES.—No better classification of the varieties of ulcers than Syme's can be given. All writers on surgery, since his time, follow the spirit, if not the letter, of his classification, and it is proposed to adopt this system here, noticing in order the following varieties of ulcers:—1. the *healing* or *healthy*; 2. *those which do not heal, from defect of action*; 3. *those which do not heal, from excess of action*; and 4. *those which do not heal, from peculiarity of action.*

**1. The healing or healthy ulcer.**

The surface is covered by granulations, which are small, sensitive, and bleed when smartly touched. There is a thin, blue, epidermic pellicle, consisting of the epidermis advancing from the edges and over the surface. The edges are on a level with the surface, of a pink tint, and free from induration. The surroundings are free from induration, and normal in appearance. The discharge consists of healthy, laudable pus. The pain is inconsiderable.

TREATMENT.—The treatment consists in helping the healing process by local and constitutional means. The local means consist, first, in rest, by position, or by splints or bandages: and, secondly, in the application of a piece of lint dipped in water or slightly stimulating lotion, to absorb discharge and protect the surface; over this a piece of oiled silk slightly larger than the piece of lint, to prevent evaporation; and then a bandage or piece of strapping over all, to fix the dressing and support the part. Should the healing of the ulcer flag, stimulating lotions are required to restore the tone. If the ulcer has involved a large amount of skin, the process of skin-grafting hastens the cure, and is an efficient means of helping the cicatrization. The patient's general health must be attended to, and the character of any retrograde change in the part will serve as a guide to such treatment.

**2. Ulcers that do not heal, from defect of action.**

(*a*) *Weak ulcer.*—The cause of this form is generally the prolonged use of emollient applications. The characters are:—The granulations look flabby, watery, gelatinous masses, and rise above the level of the surroundings, constituting 'proud flesh.' The edges are normal, but overlapped by the granulations. The surroundings are normal. The discharge is thin and watery. There is little or no pain.

TREATMENT.—It is necessary to get rid of the exuberant granulations by caustics, such as nitrate of silver or sulphate of copper in substance. Afterwards we must employ firm bandaging with astringent lotions, or powdered substances, such as oxide of zinc, oxide of zinc and starch, tannin, or sub-nitrate of lead. When at the same time the patient's health is lowered in tone, tonics and bitter astringents must be given freely.

(*b*) *Indolent, callous, or chronic ulcer.*—This sub-variety occurs when, from chronic irritation, the fibrous tissue induration is excessive, the blood-vessels reach the surface of the ulcer in too minute quantities to build up healthy granulations, and so the ulcer is perpetuated.

The surface is sunk below the level of its surroundings, is destitute of granulations, and looks glazed. The edges are raised, hard, and irregular. The surroundings are indurated, raised, and the veins in them are frequently made varicose. The discharge is thin, serous, and small in quantity. The pain at times is very great, especially at night.

TREATMENT.—The induration is got rid of by strapping tightly and evenly with soap or resin, or a mixture of soap and resin plaster; holes must

be made in the plaster to allow the discharge to escape, and the strapping should be reapplied every forty-eight hours. At each removal, the surface may be touched with caustics, or washed with a strongly stimulating lotion, as of carbolic acid, 1 to 20, or chloride of zinc 20 grains to the ounce. When the induration is gone and granulations appear, the ordinary treatment for a healthy ulcer is all that is required. Another method is to blister the surface of the ulcer with emplastrum lyttæ, or solution of cantharides, to apply a poultice over all, and to let this remain for six hours; and on removal of this, to wash the part with carbolic acid lotion, 1 to 20, and apply antiseptic dressings (*see* ANTISEPTIC TREATMENT). Still another method of treatment is by the elastic bandage; this is used for the lower extremity only. We first wash the part with carbolic acid 1 to 20, and then bandage the limb firmly and evenly with Martin's elastic bandage, from the toes upwards, covering over the ulcer. No dressing is placed over the ulcer. The bandage by continued pressure causes softening, liquefaction, and absorption of the hard surroundings; and the surface of the ulcer is bathed in the natural secretion of the part. The bandage is removed nightly, washed with carbolic acid, hung up to dry at a distance from the fire, and reapplied in the morning.

**3. Ulcers that do not heal, from excess of action.**

(*a*) *Irritable ulcers.*—These are met with on the legs of nervous and anæmic women. The surface is uneven, covered often with a grey slough. The edges are irregular. The surroundings are red and glazed, but not thickened. The discharge is a thin sanious pus. The pain is excessive, of an aching kind.

TREATMENT.—In the treatment of irritable ulcer it is necessary, first of all, to relieve pain by giving opium hypodermically or internally, and opiate or lead lotions externally. We must then remove the cause by restoring the patient's health and tone. When the pain has ceased we treat the ulcer by any of the above methods.

(*b*) *Inflamed ulcers.*—Any form of ulcer may become inflamed. This sub-variety usually arises during the course of an indolent ulcer, from derangement of the patient's health and local irritation.

The surface is covered with a greenish-grey slough. The edges are swollen, everted, red, and angry. The surroundings are red, swollen, and hot. The discharge is ichorous, offensive, often bloody, and causing irritation wherever it touches. The pain is of a throbbing kind.

TREATMENT.—The inflamed ulcer should be treated by rest, with bread-poultices properly applied; by three or four leeches, applied around the sore; or by scarification of the edges, which will allay the inflammation. After this the ordinary treatment recommended above is to be followed.

**4. Ulcers that do not heal, from peculiarity of action.**

(*a*) *Phagedænic and Sloughing ulcers.*—When an inflamed ulcer commences to spread, the edges liquefy and rapidly break down. This may take place with extraordinary rapidity, as in chancre, when it is called phagedæna, or as in hospital gangrene, when it spreads chiefly by sloughing. The patient in either case is usually in a cachectic state; the ulcerated part is dusky red, angry-looking, hot, and painful. The surface is covered by a grey or black slough, and the edges are sharply cut and undermined. *See* BUBO; GANGRENE; and VENEREAL SORE.

TREATMENT.—Rest, opiates internally and externally in the form of lotions, and careful dieting are necessary, to subdue the spread of the inflammatory action. Should this not control the action, the application of strong nitric acid will often succeed. Fresh air and disinfectants are abundantly required.

(*b*) *Varicose ulcers.*—The points to be observed about a varicose ulcer are that it follows the chronic irritation of a varicose vein; that when formed it may become indolent, inflamed, irritable, &c.; and that it frequently bleeds, from the ulcerative action extending towards and thinning the wall of a vein. *See* VEINS, Diseases of.

TREATMENT.—Varicose ulcer itself is to be treated by the ordinary methods, but the varicose vein must be supported by an elastic stocking, or, what is better when the ulcer is in a healthy state, Martin's elastic bandage.

(*c*) *Hæmorrhagic ulcers.*—Hæmorrhagic ulcers occur in persons suffering from amenorrhœa, scurvy, chronic jaundice, or hæmophilia. They possess the characters of irritable ulcers, but in addition have a special tendency to ooze blood from the surface. The blood is of a capillary-venous character, and flows freely at times.

TREATMENT.—In the hæmorrhagic sub-variety we have to attend to the diathesis with which this special form of ulceration is associated, and treat the ulcer by any one of the usual methods.

(*d*) *Syphilitic, lupoid, rodent, scorbutic, endothelial,* and *mucous* ulcerations.—These are described in separate articles.

One form of ulcer possesses so much interest to the practitioner that it calls for special consideration.

**Bed-sore.** — SYNON: Fr. *Décubitus*; Ger. *Decubitus*; *Wundliegen.*

DEFINITION.—A form of ulcer caused by continued pressure, consequent on the recumbent position.

ÆTIOLOGY.—Bed-sores are dependent either on a low condition of the nutrition of the tissues of the patient, on bad nursing, or on a combination of the two. In patients suffering from fractured spine, especially if the spinal cord be torn; in those paralysed from other causes; in cases of fractures of the lower extremity; in angular curvature of the spine; in patients suffering from hip-joint diseases; in the acute specific fevers; and in the aged—in fact, in any disease necessitating long confinement to bed, and rest in one position—bed-sores may be developed. When in addition to the illness, the nursing is badly conducted, as shown by urine, pus, blood, or any discharge whatever being allowed to remain on the part where the patient lies, a strong determining cause is set up, which will in all probability end in a bed-sore. Other strongly predisposing causes are the use of a feather bed, and

the presence of a blanket between the mattress and the under sheet, into which the perspiration from the patient's body soaks, causing the blanket to act like a poultice. Hence it will be seen that paralysis and an enfeebled state of the circulation, combined with pressure and inattention to strict rules of cleanliness, are the main elements present in the production of a bed-sore.

The various sites on which bed-sores form are arranged here in the order of frequency with which they are met:—the heel, the sacrum, the buttocks, over the trochanters, between the shoulders, on the middle of the back from the shoulders to the sacrum, on the malleoli, on the elbows, and on the calf of the leg. On the heel the usual cause is the pressure of a splint; on the elbow bed-sores frequently supervene in such cases as hip-joint disease, owing to the tendency patients have to support themselves on one or both elbows.

Anatomical Characters.—This disease is only one of the many forms of the evil results of pressure. The passage of blood through a part where pressure is great becomes mechanically difficult. Exudation from the blood-vessels takes place, causing the cuticle to be first raised, then to peel off, and finally a moist catarrhal surface results. By-and-by stagnation of the blood in the blood-vessels occurs, and as a consequence the part becomes practically dead. In the surrounding parts the blood-vessels become engorged; and the presence of the slough acting as a foreign body, the irritation causes inflammation, and an exudation of inflammatory products occurs between the living and dead parts. This takes place all around and beneath the slough, but is first apparent as a furrow on the skin. This furrow gets gradually deeper and deeper, and the process of separation extending beneath the slough, it becomes detached and finally thrown off. An ulcerating surface now results, the further history of which will vary with the patient's health, and according as the illness, which rendered confinement to bed necessary, is of a curable or an incurable nature.

Symptoms.—The premonitory symptoms of bed-sore may be either subjective or objective. Subjectively the patient complains that the bed feels hard, that there is a crease in the sheet, that there are crumbs of bread or salt in the bed; along with these generally imaginary troubles, a pricking numbing sensation is felt at the point of pressure; but on examination of the part complained of, no change may be apparent. Or, again, the complaints may be *nil*, as in the paralysed, and yet the effects of pressure may be far advanced. The objective symptoms, that is, the changes apparent in the part, may be, as in the paralysed, the first indication of the effects of pressure. These are—alteration in the colour of the skin, a roughening of the cuticle, and a variable amount of pain on pressure with the finger. Any of these is sufficient indication that preventive measures must be immediately undertaken, otherwise a bed-sore will develop. As the symptoms advance, the discoloration becomes deeper, passing from red to livid red, from purple to black. The pain, except in the paralysed, becomes for a time severe, and then finally disappears, as all nervous connexions are severed. The circulation through the part being completely stayed, a dark slough is formed, and a line of demarcation between the living and dead tissue is set up. A foul discharge runs from the part; the tissues around become red and congested; the edges are undermined; and a feeble attempt is made to throw off the central slough. Should the slough be thrown off, the muscles, fasciæ, and even the bone of the damaged part may be exposed. The general symptoms associated with bed-sores are chiefly those of the disease in the course of which this complication has supervened. In some instances a form of pyrexia may, however, be induced by the discharging ulcer itself—a condition which constitutes one form of 'bed-fever.'

Diagnosis.—The appearances described in the skin, at the point or points of pressure, are unmistakeable evidence either of the likelihood of a bed-sore developing, or of its actual presence.

Progress and Prognosis.—Should the patient recover from the illness for which confinement to bed had become necessary, the bed-sore will in all probability heal. Bed-sores, however, can scarcely be healed in those patients whose maladies do not improve, or in whom recovery does not take place. At times pyæmia supervenes; or the exhaustion, consequent on a long-continued and profuse discharge from the sore, proves too great a drain on the patient. The prognosis in regard to bed-sores developing in any individual case, will depend on the disease, the age of the patient, and the care taken in nursing. The patients in whom a bad prognosis might be given, in regard to the appearance of a bed-sore, would be the old, and the partially paralysed, especially when bad nursing is superadded.

Treatment.—It is necessary to consider this subject under the heads of (1) the *preventive* measures; (2) the treatment *when abrasions have taken place*; and (3) the treatment or cure of the *sore when formed.*

(1) The *preventive measures* have, in paralysed patients, and in patients suffering from incontinence of urine, to be commenced at the beginning of the illness, and signs of changes in the skin are not to be waited for. The part must be thoroughly cleaned, the circulation stimulated, the skin hardened, and pressure removed from the parts where it is greatest. The best means by which to gain these ends are as follows. First, we must wash the part with soap and water; and then dry it thoroughly. Secondly, a piece of cotton wool dipped in spirits of wine, eau-de-Cologne, or brandy, must be applied to the part with gentle rubbing, until the part has become thoroughly dry; and this process must be repeated three or four times at each dressing. Thirdly, a draw-sheet must be placed beneath the patient, and oxide of zinc powder sprinkled on the part on which the patient is to lie; the sheet must be changed the moment it becomes wet, whether from urine, blood, pus, or sweat. Next, we must keep the skin supple. To manage this, a very small quantity of oxide of zinc ointment or simple ointment must be rubbed into the part, until all greasy feel has disappeared. This is to follow the application of spirit. Pressure must be removed by frequent changes of position, and by suitable pads, air-cushions, water-

pillows, or water-beds. The part where the edges of the cushion press is to be treated by the same preventive measures, and to be dressed two or three times a day. Lastly, we must avoid a feather bed, and a blanket beneath the under sheet. In many cases bed-sores are caused by careless nursing, but in others the best nursing possible cannot prevent badly nourished tissues from falling into decay.

(2) When *abrasion* or roughening of the cuticle occurs, the same precautions in regard to pressure, moisture, and the use of the draw-sheet have to be observed; and, in addition, some specific applications are used. Sometimes the part is greased over with zinc or simple ointment; this is useful in certain cases, preventing urine or other irritating fluid from touching the tender parts. Over an abraded portion, soap plaster spread on amadou or linen is applied; at other times collodion or flexible collodion may be used. The best fluid applications are rectified spirit, or camphorated spirit, with one-third water; it is necessary to add water owing to the pain caused by pure spirit. The surface may also be touched with a solution of 2 grains of mercuric chloride in one ounce of spirit; or with one consisting of 5 grains of nitrate of silver to an ounce of water.

(3) The treatment of the *bed-sore itself* consists in keeping the part sweet; in aiding the removal of the slough; in applying some one of the many stimulant and disinfectant lotions in use; and in preventing the neighbouring tissues from breaking down. To clean the parts, and hasten the removal of the slough, we must apply a bread-and-water poultice. When the discharge is foul, the part should be washed with Condy's fluid between each application of the poultice; and, to overcome the odour and sweeten the part, a poultice of half linseed-meal and half charcoal should then be applied, and changed every three hours. Poulticing should not be continued longer than is necessary to clean the surface, as the heat and moisture tend to soften and weaken the parts, and permit of their rapidly breaking down.

Stimulating and disinfectant dressings are employed in one or other of the following methods. Cut a piece of lint the exact size of the sore; soak it in some stimulant and disinfectant lotion, such as carbolic acid, 1 in 40, or the red lotion, or the compound tincture of benzoin, the balsam of Peru, or the tincture of myrrh or of catechu; and apply it exactly within the edge of the sore. Over this piece of lint place a piece of oiled silk or guttapercha tissue, a fraction larger than the lint used; and over this again three or four large folds of lint or amadou, with a hole cut in the centre corresponding to the sore.

In place of the folds of lint and amadou, pads or water-cushions might be used to take the pressure off. When the slough is large, lotions and poultices should not be applied to it, as the moisture only favours putrefaction. To prevent this, we may place a piece of oiled silk or guttapercha tissue exactly over the slough; and the lint, dipped in one of the above-mentioned lotions, when applied over it, can only touch the sore at the ulcerating furrow between the living and dead tissue. All dressings should be fixed by diachylon plaster, and not by a bandage, owing to the heat and moisture engendered by use of the latter.

The neighbouring tissues must be treated with the preventive measures mentioned above.

When the slough has separated, an attempt is to be made to heal the part by improving the patient's general health, provided the existing malady permits. The usual precautions have to be taken with the surrounding parts; and the ulcer treated by one of the methods recommended under the head of ulcers that do not heal from defect of nutrition.

JAMES CANTLIE.

**UMBILICAL REGION.**—This is the central region of the abdomen, corresponding to the umbilicus and its vicinity. The principal structures which normally lie underneath it are the great omentum, and part of the transverse colon and small intestines, with the deep structures situated in front of the spine. The stomach often reaches the umbilical region when distended after a meal.

CLINICAL INVESTIGATION.—There is nothing special to say on this point, the ordinary methods of abdominal examination being applicable in the investigation of the umbilical region. The following points may be noticed with regard to the abnormal conditions met with in this region.

1. When the stomach is diseased, it is often so distended as to reach the umbilical region. The liver also, either when enlarged or displaced downwards, frequently extends to this region. More exceptionally the spleen or kidney may attain such a size as to encroach upon it. Enlarged organs or tumours may also ascend thus far from below, as in the case of the uterus and ovaries; and even a distended bladder may rise to this height.

2. In general enlargement of the abdomen the umbilicus and its vicinity often give useful information in determining its cause. Thus, when the enlargement is due to fluid in the peritoneum, the umbilicus tends to become stretched, everted, obliterated, or pouched out, which is not the case in other forms. In some instances of portal obstruction it not only projects, but has a peculiar feel, due to the presence of enlarged and thickened veins. Moreover, the percussion sound in this region remains tympanitic, and sometimes even excessively so, when the rest of the abdomen is universally dull. On the other hand, when the enlargement is due to an organ or tumour, this is not observed, and the umbilical region is often dull when the flanks are resonant. An important element in the diagnosis of ovarian tumour is often thus afforded.

3. Should a very small quantity of fluid be present in the abdominal cavity, this may be detected by placing the patient on his hands and knees, when the fluid gravitates towards the umbilical region, and can be discovered there by percussion.

4. The umbilicus itself may be the seat of disease, such as inflammation, eczema, or gangrene. These conditions are most important in infants, and soon after birth peritonitis may be set up by the extension of irritation from the umbilicus inwards.

5. The umbilical portion of the abdominal

wall is liable to be involved in malignant disease affecting the underlying great omentum, to which it then becomes fixed, so that it cannot be moved.

6. Umbilical hernia is an important form of hernia, of which the writer has seen several examples. It may attain a very large size. Moreover, in connection with this condition, much thickening and induration may be met with about the umbilicus, as the result of a chronic inflammation. The writer has met with one case presenting these changes in a marked degree. FREDERICK T. ROBERTS.

**UNCONSCIOUSNESS.**—Loss of consciousness or mental perception. *See* CONSCIOUSNESS, Disorders of.

**UNDERCLIFF, on the South Coast of the Isle of Wight.**—Extends from Bonchurch to Niton. A mild, tonic climate. *See* VENTNOR; and CLIMATE, Treatment of Disease by.

**UNILATERAL FACIAL ATROPHY.**—SYNON.: Progressive Facial Hemiatrophy; Neurotic Facial Atrophy; Fr. *Aplasie lamineuse progressive*; Ger. *Prosopodysmorphia.*

In this affection the whole of one side of the face becomes notably smaller than its fellow, owing to an atrophic condition of the subcutaneous tissues and of the skin, together with atrophy of the muscles, and sometimes even of the bones on the affected side of the face. The pathology of this rare progressive atrophy of one side of the face is involved in considerable doubt. It has been regarded by some as an essential atrophy; by others, as a result of disease in certain hypothetical 'trophic nerves'; by others as a result of irritation acting upon the fifth nerve, and on the portio dura of the seventh cranial nerve; and, finally, as an effect of persistent irritation acting upon the cervical sympathetic, especially in its upper and middle ganglia. These ganglia have been found distinctly tender on pressure being made over them; and the latter view as to the pathology of the affection would seem to be still further borne out by the fact, that marked amelioration has been produced in some cases by the long-continued application of a continuous current, of weak tension, to the cervical sympathetic ganglia.

H. CHARLTON BASTIAN.

**UNILATERAL HYPERIDROSIS.**—SYNON.: *Hyperidrosis*, or *Ephidrosis unilateralis.*—Excessive perspiration on one half of the body, occurs more or less habitually, or only after exercise. It may be limited to one side of the face and head, or the neck may be included; or it may implicate the whole of one half of the body. It has sometimes, and especially when limited to the face and neck, appeared as one of the symptoms due to paralysis of the cervical sympathetic nerve. In other cases no such relation has been ascertained to exist. *See* SYMPATHETIC SYSTEM, Disorders of.

TREATMENT.—In the absence of definite information as to the pathology of this affection it is not possible to indicate any rational principles of treatment. Empirically some of the remedies used for checking perspiration, such as zinc, belladonna, and quinine, may be tried. *See* PERSPIRATION, Disorders of.

H. CHARLTON BASTIAN.

**URÆMIA** (οὖρον, urine, and αἷμα, the blood).—SYNON.: Fr. *Urémie*; Ger. *Urämie.*

DEFINITION.—This term is applied to a group of nervous symptoms, which occasionally occur in the course of acute or chronic Bright's disease, as well as in other maladies which prevent the secretion or the discharge of the urine.

ÆTIOLOGY AND PATHOLOGY.—The circumstances in which uræmia arises are pretty well ascertained, but the connection between these circumstances and the symptoms is still obscure. It occurs when there is interference with the secretion or the discharge of urine. It is thus met with in all the forms of Bright's disease; in cystic, tubercular, and cancerous disease of the kidney; in suppurative nephritis; and in cases of anuria, either of obstructive or of non-obstructive origin. But some of these conditions frequently exist for long periods without uræmia being developed, and it is sometimes developed unexpectedly without apparent alteration of the patient's state. The attack is, however, precipitated frequently by pregnancy and parturition; by indulgence in alcohol; sometimes by the recurrence of the menstrual period; and probably by intercurrent disease. But the occurrence of these conditions does not in all cases suffice to induce it, for many women suffering from Bright's disease pass through pregnancy and labour without manifesting uræmic symptoms, and so with other inducing causes.

Of the exact nature of the uræmic process we are unable to speak at present with certainty. Two sets of explanations have been suggested—namely, the *mechanical* and the *chemical.* Dr. Owen Rees, in this country, and Prof. Traube, in Germany, have been among the chief exponents of the mechanical explanations. The former dwelt upon the wateriness of the brain in many cases of uræmia; the latter suggested processes by which that œdema might arise. Sudden increase of blood-pressure, and sudden increase of the proportion of water in the blood, might, he thought, suffice to account for the condition. Rosenstein and others have lent the weight of their authority to these views. Monck has sought to demonstrate by experiment that cerebral œdema from increased pressure may produce the result; but even if these experiments had been correct, which is doubted by many, it cannot be denied that there are many well-marked cases of uræmia in which there is no encephalic œdema. The observation of Popoff, which refers the changes to accumulation of altered corpuscles within the cerebral capillaries, may prove important, if it should be confirmed by other authorities.

Among the chemical theories one of the earliest was that which referred the process to retention of urea, but many difficulties arise in connection with this. The very ingenious theory of Frerichs, which referred the process to decomposition of retained urea by the action of a ferment, must now be held to be disproved, in consequence of evidences discovered, both of a negative and of a positive kind. The evidence at present before

us seems to point to the probability of the process being due to retention of some excrementitious material or materials.

Symptoms.—All the functions of the nervous system are occasionally involved in uræmia. Among the disorders of the sensory function the most common are pain, especially in the head, sometimes very intense and persistent; dimness of sight, or actual blindness of one or both eyes, sometimes attended by no change in the retinæ, at others by retinitis albuminurica; ringing in the ears; and sometimes deafness. Among the motor changes the most striking are the general convulsions or twitching of muscles; the tendency to vomiting; and sometimes extreme dyspnœa. Among cerebral and mental derangements, drowsiness, torpor, coma, and delirium are the chief.

The forms of uræmia generally recognised are the *chronic* and the *acute*.

1. **Chronic Uræmia.**—This comes on gradually, and may at first scarcely attract attention; the habitual listlessness and indifference of manner observable in cases of Bright's disease becomes increased. Movements are slow, and speech is somewhat indistinct. There is often dimness of sight, ringing in the ears, uneasiness in the head, or violent and persistent headache. The condition of the patient varies; the symptoms occasionally pass away, but they constantly recur and become by degrees more intense. The drowsiness passes into torpor. If the patient is roused to speak, his articulation is thick and indistinct. It soon becomes impossible to elicit any answer; lethargy deepens into coma; the breathing becomes stertorous, or rather hissing in character, the air being driven against the teeth or hard palate; and death supervenes. Sometimes, instead of silence, a rather noisy delirium comes on, in which wild prolonged howls alternate with muttering, and occasionally with paroxysms of excitement. Sometimes, again, there is a low prolonged muttering, with a repetition of the same expression time after time. Subsultus tendinum and twitching of the facial muscles are commonly seen throughout. Convulsions, vomiting, and diarrhœa are frequent symptoms; epistaxis also occurs, but more rarely. This form of uræmia is a common mode of fatal termination in cases of chronic Bright's disease. It sometimes occurs—but much more rarely—in the early stage of the inflammatory form.

2. **Acute Uræmia.**—This includes all the varieties in which the symptoms are suddenly developed. There are three common forms—the comatose, convulsive, and mixed; and several less common, namely, the delirious, dyspnœtic, ocular, and articular. In the acute *comatose* form, after headache, giddiness, affection of sight, vomiting, or delirious excitement, coma is rapidly developed; or it may supervene without such premonitory symptoms. The face is usually pale; the pupils are dilated or unaltered, and react slowly to light; or, on the other hand, there may be a red spot on the cheek, injected conjunctivæ, and contracted pupils. There is a peculiar stertor, not the deep snoring of hæmorrhagic apoplexy, but a sharper, more hissing sound, produced by the rush of expired air on the hard palate or teeth. The coma may rapidly deepen, and death ensue within a few hours; or, on the other hand, the patient may rally and continue free from the symptoms permanently; or sooner or later uræmia recurs in one or other of its forms; and issues in death. Acute uræmic coma occurs in all of the forms of Bright's disease, but is most frequent in the inflammatory and cirrhotic varieties.

The second acute type is the *convulsive*, which may almost exactly simulate epilepsy; or be unattended by loss of consciousness; or may affect certain groups of muscles, and simulate tetanus. The attack comes on suddenly, with or without warning. The attacks may be single and solitary; or they may occur in rapid succession, five or six, or even more, in the course of twelve hours. They may be recovered from; or they may prove rapidly fatal, either during the paroxysm, or in the coma which succeeds it. They occur in all the forms of Bright's disease, but most frequently in the cirrhotic and in the inflammatory form. The existence of cirrhosis of the kidney is not unfrequently first revealed by the occurrence of convulsions.

The other types of uræmia, namely, the *mixed*, in which sudden coma occurs with convulsions, the *delirious*, in which the ordinary symptoms are replaced by restless delirium; the *dyspnœtic*, in which there are sudden attacks of breathlessness, without corresponding change in the physical signs of the lungs or heart; and the *articular*, which Jaccoud has described as presenting many features in common with acute rheumatism, are so rare that they need not be described here.

Diagnosis.—There is little difficulty in distinguishing the chronic form of uræmia when fairly established. The most important evidence is, of course, afforded by examination of the urine. Uræmia sometimes resembles fever or meningitis; but the history of the illness, the state of the urine, the temperature, and the mode of breathing, suffice to distinguish it from these conditions.

The acute form of coma may closely resemble hemiplegia with loss of consciousness, but differs in the absence of paralysis of one side, and also in the character of the breathing, while the condition of the urine also affords important indications.

The convulsive type may resemble epilepsy, but it has rarely the initial cry, the corpse-like pallor, the predominance of convulsions on one side, the turning in of the thumbs on the palms, and the loss of reflex irritability, The chief reliance is to be placed on the analysis of the urine, because, although after true epilepsy albumen may be present, and urea may perhaps be diminished for a time, the secretion soon returns to its natural condition, while in uræmia it is always distinctly albuminous. From opium-poisoning it is distinguished by the condition of the pupils, and the examination of the secretion. From belladonna-poisoning it is to be distinguished by the same considerations.

Prognosis.—The occurrence of uræmia in a case of Bright's disease is always grave; the chronic form is hopeless, and when it occurs the duration of life cannot be long. The acute forms are often recovered from; they sometimes subside spontaneously, but when they are due to

chronic renal disease, death cannot, as a rule, be regarded as far off. When they result from acute disease, they are not so hopeless, because the conditions on which they depend are frequently removed by treatment. Puerperal cases, although involving great immediate danger, are very frequently recovered from, probably because they owe their origin to a combination of circumstances which do not long persist.

Treatment.— The first indication is to seek to re-establish the suppressed secretion of the kidneys. For this purpose, dry cupping, wet cupping, leeching, or poulticing over the loins, and the administration of digitalis and other non-irritating diuretics, are indicated. Frequently the blood must be relieved more rapidly than the action of the diuretics can accomplish. Venesection, to the amount of eight, ten, or more ounces, may be of use, especially in the puerperal forms, and the acute inflammatory cases. Purging with hydragogue cathartics, such as elaterium, or compound powder of jalap, or jalap and scammony; diaphoretics, such as pilocarpine subcutaneously or by the mouth; and the hot pack—any of these methods may often relieve the system until there is time for the diuretics to act. When the convulsions are severe, sedatives, such as bromide of potassium and hydrate of chloral, are useful; and although some writers oppose its use, on the ground that it meets merely a symptomatic indication, chloroform is of great value. It quiets the nervous system, and checks the convulsions more rapidly than anything else, but the tendency to coma in the individual case must be carefully kept in view while chloroform is being administered. Tonic remedies, and articles of diet such as milk (which is at once nourishing and powerfully diuretic) should be given, to ward off a return of the symptoms in cases in which the uræmia has disappeared. In puerperal cases an obvious and important indication is to complete the labour with as little delay as possible.

Grainger Stewart.

**URETERS, Diseases of.**—Synon.: Fr. *Maladies des Uretères*; Ger. *Krankheiten der Harngänge.*

Morbid conditions of the ureters are so generally parts of, or associated with, diseases of the bladder or kidney, and so naturally come to be described in the articles treating of these several diseases, that a separate account or distinct classification of them is perhaps scarcely called for; and a brief description of the most important will be sufficient for all practical purposes.

1. **Congenital Malformations.**—A double ureter is the most frequent malformation, the division sometimes reaching as far as the bladder. In very rare cases a triple ureter has been found. Congenital malformations, leading to more or less complete obstruction of the ureter, are found most often near the pelvis of the kidney. If the obstruction is complete, it gives rise to hydronephrosis (*see* Hydronephrosis). If incomplete, a slighter degree of the same condition results, the pelvis and calyces becoming dilated, and the kidney-substance atrophied and indurated. The chief congenital obstructions are—1st. Total obliteration of the ureter as it leaves the pelvis. 2nd. Valvular opening from the pelvis into the ureter. This becomes gradually more complete as the dilatation of the pelvis increases. 3rd. A spiral arrangement of the ureter. 4th. An abnormal renal artery pressing on the ureter as it leaves the pelvis. The incomplete obstructions frequently give way at intervals, when there will be a copious flow of urine, usually of low specific gravity and pale colour. One instance has been recorded, in which alternate contraction and dilatation existed.

2. **Acquired Obstruction.**— *Complete* obstructions which are not congenital may arise:— First, from impaction of a renal calculus; this may take place at any point, the most frequent being at the vesical orifice. Secondly, from pressure of tumours or other conditions, such as uterine cancer, pelvic tumours, fibrous bands, enlarged glands, or fæcal accumulations, in which case the condition would at first be incomplete. *Incomplete* obstruction arises most frequently from impediments to the discharge of urine, existing in the prostate or urethra. In the former case, the bladder being in a state of constant overdistension, the valved opening of the ureter is closed with unnatural force. In the latter the hypertrophy of the bladder increases the length of the portion of ureter lying in the bladder-walls, and the bundles of muscular fibres more or less constrict the orifice. Any cause giving rise to hypertrophy of the bladder will therefore tend to obstruct the orifice of the ureter, as is seen in chronic cystitis, stone in the bladder, and other conditions. The opening is still further narrowed, in many cases, by swelling of the mucous membrane, the result of sub-acute or chronic inflammation. Occasionally the orifice may be partially obliterated by a villous growth in the bladder. *Stricture* of the ureter is found in rare cases, apparently the result of previous inflammation and ulceration. Slight obstruction may occur during pregnancy, from the pressure of the gravid uterus.

3. **Dilatation.**—The part of the ureter above any obstruction is always found more or less dilated, according to the degree and the duration of the impediment. If the condition be acute and complete, little or no hypertrophy of the coats of the ureter will be found; but if chronic and incomplete, its walls will be thickened, both by fibroid change, and by hypertrophy of the muscular coat. The dilated ureter is always tortuous, being increased in length as well as in diameter, and may even resemble a portion of small gut. The mucous membrane is always opaque and somewhat thickened, occasionally red and injected, and frequently pigmented from previous attacks of inflammation. A largely dilated ureter may sometimes be felt through the abdominal wall. There will probably be some degree of pain or uneasiness in the course of the canal, or in the loin; and a tendency to sickness.

4. **Inflammation.**—*Simple* inflammation of the ureter is frequently found, as an extension either from the bladder or from the pelvis of the kidney. *Septic* inflammation accompanies septic pyelitis, due to extension of decomposition from the bladder to the pelvis of the kidney,

*Scrofulous* or *tubercular* inflammation almost invariably accompanies a similar condition of the bladder or pelvis.

5. **Malignant Disease.**—Cancer may extend from neighbouring organs into the ureter, but there is no reason to believe it ever primarily takes origin there.

Neither the diagnosis nor the treatment of an affection of the ureter can be separated from that of the disease to which it is secondary.

MARCUS BECK.

**URETHRA, Diseases of.**—SYNON.: Fr. *Maladies de l'Urèthre*; Ger. *Krankheiten der Harnröhre.*—The affections of this canal comprise urethritis, with its various consequences, such as gleet, warts, peri-urethral abscess, inflamed follicles, neuralgia, and stricture; also syphilis and soft chancre. For descriptions of most of these affections the reader is referred to the articles GONORRHŒA; GLEET; SYPHILIS; and VENEREAL SORE. Some forms of urethritis, neuralgia, and stricture remain for consideration here; whilst certain other pathological relations involving the urethra will be briefly referred to.

1. **Urethritis.**—The origin of urethritis is not exclusively due to contagion; inflammation of the tract, which differs mainly by less accentuation of its features from contagious urethritis, is produced by injury, by gout, or even by tubercular disease. A very mild form of urethritis is an occasional concomitant of early syphilis. It subsides spontaneously, and is always very limited in amount. The distinction of these forms from gonorrhœal urethritis is not always marked. In traumatic inflammation the signs of irritation follow immediately on the passage of the foreign body, such as a stone or a catheter; soreness or scalding attends the first subsequent micturition; and swelling and discharge follow, at most twenty-four hours later. In gouty urethritis the inflammation may be as severe as in well-marked gonorrhœa, and attended by the complications of the testes, bladder, eye, or joints which are met with in cases of gonorrhœa. The leading distinctions of gouty urethritis are the milkiness of the discharge; the absence or small amount of swelling of the fore part of the urethra; though the scalding in the perinæum and irritability of the bladder are severe.

Asparagus and arsenic are said to have the power of producing urethritis in some persons. Tubercular urethritis is always a very indolent affection, being due to the slow degeneration and ulceration of tubercular deposits in the deeper portion of the canal. In such cases the irritability and inflammation of the bladder are always more urgent than the urethritis; while the evidence of tubercular disease in other parts of the body is usually sufficient for diagnosis.

2. **Urethral Fever—Sympathetic Irritation.**—Besides inflammation and its complications, the urethra is the source of the conditions termed *urethral fever*, and *sympathetic irritation* of the nervous system, excited by certain states of the urethra. Also, on the other hand, the urethra is occasionally the seat of certain symptoms which are caused by disease of different organs. For example, the passage of a calculus along the ureter will determine pain in the urethra. Injury of the other parts of the body, such as fracture of the femur, may excite spasm of the deeper muscles of the urethra, and thus produce retention of urine.

3. **Neuralgia.**—The causes of pain felt in the urethra, but not necessarily due to disease of that part, are numerous. Gouty irritation is frequent; and a nervous condition produced by prolonged debauchery of various kinds is also not uncommon. The gouty state is relieved by treatment of the diathesis; the nervous irritation by suitable general treatment, to which may often be added local applications which have the effect of dulling the sensibility of the urethra, such as the passage of sounds, and the use of astringent or (in obstinate cases) of caustic injections to the deeper portions of the urethra.

4. **Stricture.**—The average distensile capacity of the urethra has a diameter of ten, or a circumference of thirty, millimètres. This measure varies in different portions, being widest at the portion behind the transverse ligament (anterior layer of the deep perinæal fascia), slightly less in the bulbous portion, and least at the meatus. This outlet is indeed frequently considerably narrower, varying between a mere pinhole and a diameter of fourteen or fifteen millimètres, the most common size being twenty-five millimètres. The urethra in different persons ranges between twenty and forty millimètres in its general distensile capacity.

Strictures are abrupt abnormal contractions of the urethra at any given point of its course, and may be subdivided into (*a*) *spasmodic*, or those due to temporary contraction of the muscular fibres surrounding the canal; (*b*) *inflammatory*, or those caused by swelling and congestion of a limited area, this condition being usually associated with more or less muscular spasm; and (*c*), *organic*, where unyielding fibrous tissue replaces the normal dilatable structure of the urethral walls. In the cases of fibrous thickening, the narrowing is often much increased by muscular contraction.

(*a*) *Spasmodic*; (*b*) *Inflammatory Stricture.*—The *spasmodic* stricture, which is always a temporary affection, is caused by muscular contraction from reflex irritation, the existence of inflammatory swelling being one of the most frequent, but the passage of a calculus or a catheter may also excite it. Again, the presence of a fibrous stricture near the meatus will frequently excite reflex spasm of the deep perinæal muscles. The *inflammatory* stricture is due to swelling of the deeper part of the urethra during inflammation. It is a not unfrequent complication of acute gonorrhœa. The spasmodic and inflammatory strictures, being temporary ailments, involve no permanent lesions. Their treatment is mainly general, consisting in the removal of irritation and congestion by salines, purgatives, and warm baths; and in the relief of retention of urine, if present, by passing a flexible catheter (No. 5 or 6 of the English scale).

(*c*) *Organic Stricture.*—Organic stricture is produced sometimes by the contraction of scars, following injury; but in the larger number of instances it is the result of long-continued inflammation of the sub-mucous tissue following gonorrhœa.

Organic strictures may be situated at any part of the urethra except the prostatic, being numerically most common in the first inch from the meatus. But the thickest and toughest strictures are generally found near the juncture of the bulbous and membranous portions of the urethra, that is, about five inches from the meatus. The membranous portion is only affected when large development of cicatricial tissue reaches backwards from the bulb. This new tissue is developed in various forms, namely, (*a*) as a membranous fold (*bridle stricture*) of which the fibres cross, and occasionally encircle, the axis of the tube. Bridles may be either single or several. (*b*) As warts and superficial scars left by ulcers, which form patches of tough tissue. (*c*) As indurated areas or fibrous nodules of the submucous layers, which stand forward on the surface of the urethra, causing irregular projections, as well as unyielding contractions. Thus they twist the course of the canal, and impede the passage of bougies. Or, instead of being in limited patches, the induration may form evenly along the canal, making it smooth and gristly for a large part of its length, with a narrow passage through the centre. The depth of the fibrous contraction may form only a single layer of fibres beneath the mucous membrane, or may infiltrate the whole thickness of the corpus spongiosum, or it may even spread through the perinæum till it converts that region into a dense gristly mass.

Strictures vary in behaviour: some yield easily to dilatation, and slowly contract; others are rigid, and can be dilated only to a small extent. Lastly, some expand quickly, but as quickly shrink back to their previous narrowness.

The mucous surface of a strictured urethra varies much. It is smooth and almost healthy where the stricture is of no great duration; but in diseases of long standing the lining membrane between the meatus and the narrowest contraction is often puckered with fresh induration, or excoriated, or ulcerated; and sometimes just in front of the main stricture artificial perforations are found, the results of inexpert instrumentation, leading backwards outside the stricture, and ending either as blind-alleys, or opening into the urethra or rectum behind the stricture, constituting 'false passages.' At the stricture itself the surface is dull and roughened, while behind it the urethra is often dilated, pouched, and ulcerated, its surface being beset with shreds of thickened muco-pus. Occasionally the pouches have given way into the cellular tissue, and form abscesses around the urethra; or, if they have pushed their way to the surface of the body, they end as fistulæ of the perinæum or scrotum. The remainder of the urinary apparatus is often affected; the bladder has thickened walls, and is the seat of chronic inflammation; the ureters are dilated and similarly inflamed. The condition of the kidneys varies; sometimes but slightly affected, in cases of long standing they may be greatly diseased. If so, the pelves and calyces are widely expanded; the pyramids are flattened, and partly destroyed by fibrous interstitial degeneration; the cortical substance is wasted, and displays other consequences of prolonged chronic irritation.

Symptoms.—The symptoms of urethral stricture are the more evident the narrower it is, and the longer it has existed. Few symptoms attract observation before the stricture is well advanced. The most common and earliest is a scanty muco-purulent discharge. This sign is indeed very often the indication of the chronic inflammation of limited areas of the tract which end in stricture. Those signs which appear when the stricture has developed are—small size of the stream; straining; frequent call to pass urine; and pain in passing it. Any or all of these may be absent, even when the canal has lost as much as two-thirds of its distensibility. Usually to these troubles are added occasional attacks of complete retention of urine.

Treatment.—The treatment of stricture consists, first, in removing from the habits and diet of the patient all causes of functional disorder. Temperance in alcoholic drinks, in stimulating or highly nutritious foods, in sexual indulgence, and in some forms of exercise, such as horse- and bicycle-riding, must be enforced. Due attention to the condition of the skin and bowels, and sufficient bodily exercise, are requisite. By these means the temporary and dangerous aggravation of the sufferings caused by stricture will be avoided. Next comes the local treatment. The passage must be restored to, and maintained at, such width as, on the one hand, will enable the bladder to empty itself completely by each act of micturition; and, on the other, will allow a sufficient margin to prevent stoppage of the flow of urine during occasions of temporary swelling or spasm of the urethra. Such an expansibility would seem for most persons to be about one inch or three-quarters of an inch in circumference, that is about No. 10 (English scale), though in practice it is advisable to dilate somewhat further than this to allow sufficient margin for neglect. In all organic strictures there is a tendency to contract; hence when sufficient expansibility has been established, it must be maintained by the frequent passage of a bougie. In most cases the patient should learn to do this for himself.

The methods employed for widening the urethra at its unyielding parts are—(*a*) *gradual interrupted dilatation;* (*b*) *gradual continuous dilatation;* (*c*) *cutting or splitting from within;* and (*d*) *cutting from without.* Other methods, such as the use of caustics or the cautery, have dropped into desuetude.

(*a*) *Gradual interrupted dilatation.*—This is procured by passing sounds or flexible bougies (preferably the latter) through the stricture, beginning with that size which will just pass through, and in subsequent sittings increasing the size of the instrument without wounding the urethra, until the requisite size (No. 12 or 13 English) is reached.

(*b*) *Gradual continuous dilatation.*—This method consists in passing through the stricture a flexible catheter, small enough to slip easily through the contraction, and tying the instrument in the passage. As the urethra widens, the catheter must be replaced from time to time by a larger one, lest, being loose, the instrument escape from the passage. A week or ten days usually suffices to bring the stricture to the requisite dimension. The nature of the process appears similar

to that of a seton in ordinary sinuses or cellular tissue; the fibrous tissue becomes loose and succulent, its fibres permeated by leucocytes, and partial disintegration into pus takes place.

(*c*) *Splitting or cutting from within.*—In splitting the stricture from within (forcible dilatation, divulsion, 'immediate treatment') the unexpanding fibres are rent asunder by an expanding instrument previously introduced in a contracted condition.

In cutting, by means of a sound or guide passed through the stricture, a sharp edge is applied to the narrowed parts until they are divided sufficiently to give the urethra ordinary dimensions at that point.

(*d*) *Cutting from without.*—When attacked from without, the urethra is reached from the perinæum either with a guide-staff passed to the bladder, indicating the course of the urethra, or, if that be impracticable, by a sound passed along the urethra to the seat of stricture, which is then exposed by incision. The orifice of the stricture being then visible, a fine director is passed along it to the bladder, and its fibres divided from before backwards.

Various instruments have been devised, and are employed for carrying out these several principles—some more suited than others to particular cases.

Gradual interrupted dilatation least interferes with the patient's avocations, is least attended by evil consequences, and is most effectual in strictures of recent formation, situate near the bulb. It is applicable in a larger number of cases than any other form of treatment. Objections to this method are the rapidity with which recontraction takes place; and the impossibility in some patients of dilating the stricture beyond a certain calibre without exciting shivering, pain, and pyrexia, or even local inflammation and abscess.

Gradual continuous dilatation is easy and rapid, but it is liable to be followed by speedy recontraction; it excites in some patients constitutional fever and local irritation sufficient to require its abandonment. Hence gradual continuous dilatation is useful to obtain a speedy enlargement of a very narrow stricture in cases of advanced vesical or renal disease, where it is requisite to give the bladder rest without delay, yet the condition of the kidneys is most unfavourable to any operation. Forcible dilatation and divulsion have the disadvantage of putting the patient to the suffering of a painful operation, while not protecting him from rapid shrinkage of his stricture.

Internal urethrotomy is applicable with best results to young persons, in whom renal changes have seldom advanced much. It is also preferable for those patients in whom gradual dilatation, either by interrupted passage of bougies, or the tying in of catheters, cannot be borne. The locality of stricture has much to do with deciding upon the adoption of internal division. Serious disturbance rarely follows incisions made in strictures between the meatus and the bulb. Again, the shallow constrictions, the so-called 'bridle' strictures, and the elastic, rapidly-yielding, and as rapidly-shrinking strictures, are always situate in this portion. They are specially amenable to incision, while very little affected by the passage of bougies. The great thickness of certain strictures of the bulb renders their division the only mode of securing even moderate duration of their dilatability.

The re-contraction after treatment has established sufficient distensibility would seem to follow less speedily after division than after gradual dilatation.

External urethrotomy is needed in comparatively few cases. It is advisable when the perinæum is hardened and beset with fistulæ; or in those still more rare cases where no instrument can be introduced into the bladder. Under such circumstances it is requisite to attack the stricture from the surface. BERKELEY HILL.

**URIAGE, in France.**—Muriated sulphur waters. *See* MINERAL WATERS.

**URIC ACID DIATHESIS: URIC ACID CALCULUS.**—SYNON.: Lithuria; Lithiasis; Nephrolithiasis; Fr. *Diathèse urique*; *Calcul urique.*

ÆTIOLOGY AND PATHOLOGY.—Uric acid is undoubtedly the outcome of the proteid tissues of the body, and it is also derived from the nitrogenous elements of the food; but where and by what agency this metabolism is effected is unsettled. By some physiologists it is considered that the liver is the chief source of uric acid, and this theory is grounded on these facts—that urea is produced in the liver; that urea and uric acid are nearly allied, and often replace each other; and that in so-called liver-disorders, there is frequently a deposit of uric acid in the urine. On the other hand, the liver contains but the merest trace of uric acid; the blood in the hepatic vein contains no more than that in the portal vein; uric acid is found in decided amount, and always, in the spleen; and as all the blood from it passes through the liver, so that which escapes from the liver may have come to this organ from the spleen with the blood-stream. In what relation does the kidney stand to the formation of uric acid? On this point also authorities differ. Many hold that the kidney merely filters it from the blood. But there is much evidence to support the belief that the function of the kidney, as regards both urea and uric acid, is more important than mere excretion; that it has the power to form and produce, as well as simply to eliminate, these nitrogenous constituents out of some antecedents in the blood; and that as the hepatic cell has the power to form bile, so the epithelial cell of the renal tubules, by the metabolic activity of its protoplasm, has the power to produce some of, if not all, the urea and uric acid found in the urine. It is most probable that the water and saline constituents of the urine are simply eliminated from the blood by osmosis through the blood-vessels of the glomeruli, and are, therefore, influenced as to excess or deficiency, by greater or less blood-pressure, whilst the uric acid, urea, pigments, and other constituents are, in part at least, the result of a true secreting power of the renal cells in the tubules.

The quantity of uric acid excreted does not

appear to vary much whether vegetable or animal food be exclusively taken. Lehmann found this to be the case in his own person, and it is certain that excess and deposit of uric acid is very common amongst the poor, who consume but little animal food. The amount of uric acid secreted is sometimes very considerable; it may be roughly estimated by adding hydrochloric acid to a definite quantity of urine, and washing and weighing that which is precipitated. Dr. Pavy has suggested a more ready and accurate method, namely, by its reducing action on the oxide of copper (*Med.-Chir. Trans.* vol. lxiii. p. 217).

Characters.—Uric acid exists in the urine in combination with alkaline bases. When these bases are deficient, or when the uric acid is in excess, precipitation occurs, and the well-known red particles are visible. Under the microscope they appear in various forms: rhombic crystals, stars, bundles, tablets, and prisms. Pure uric acid is colourless, but, clinically, it is always tinged brown or orange-red. It is so slightly soluble in water as to require 12,000 to 15,000 parts; consequently a very slight excess of uric acid or diminution of the water of the urine leads to deposit. It is insoluble in dilute acids, but readily dissolves in alkalies and their carbonates. When combined with potash, ammonia, and soda, it forms the thick brick-dust sediment so commonly seen in most febrile diseases. These 'mixed urates' are amorphous; soluble by heat; form frequently an opaque film on the surface of the urine; and such is their affinity for the urinary pigments, that they generally, but not always, leave a reddish stain on the utensil.

Calculi or concretions composed of pure uric acid vary in size, from the well-known red granules or gravel up to masses of many ounces in weight. They are generally of a reddish-brown colour; very dense and hard; indistinctly stratified; of a flattened oval shape; of a rough tuberous exterior when single, and smooth and facetted when multiple. To this, however, some exception should be made, for it is not uncommon, when only two or three co-exist in the bladder, to find them rough and mammillated, as if there had been no contact or rubbing between them. When uric acid is combined with ammonia and potash in a concretion, the colour is paler, the lamination more distinct, and its texture more friable. Pure uric acid calculi, when broken by the lithotrite, form sharp angular fragments; the urate concretions, on the other hand, break more readily and assume the form of flaky laminæ.

Symptoms.—The occasional deposit of uric acid and urates, even in large quantity, is sometimes observed without the least disturbance of health; frequently, however, it is accompanied by local irritation of the kidneys and bladder, as shown by frequent micturition, with heat and even pain during the act; and by flatulence, heartburn, and other signs of indigestion. There is, however, no habit of body, no recognised symptoms of so definite a kind, which are plainly due to, or accompanied by, an excess of uric acid, as to warrant the continued use of the term 'uric acid diathesis.' Heartburn, flatulence, and other signs of indigestion and liver-disorder may, and often do, exist without any deposit of uric acid or urates, and when they co-exist there is nothing to show that the one depends on the other; the utmost that can be said is that the presence of uric acid points a way to successful treatment. Uric acid and its salts are found *in excess* in many organic diseases; in maladies of the heart and lungs in which oxidation of the blood is so frequently deficient; in organic diseases of the liver; in almost all febrile diseases; and sometimes associated with diabetes, chorea, and certain skin-diseases. They are *deficient or absent* in advanced diseases of the kidney; in some cases of lead-poisoning; in general anæmia; and in some exhausting non-febrile diseases. The relation of uric acid to gout is interesting and important. In the acute stage the daily secretion of uric acid is diminished, notwithstanding that there is frequently a copious deposit of pink urates; but the normal quantity is restored or exceeded as the attack passes off. In chronic gout uric acid is markedly deficient or wholly absent, while the amount of urea continues steady and almost up to the average in health. *See* Gout.

Treatment.—It will be apparent that the treatment of uric acid in excess must be comprised in that of the various diseases in connection with which it occurs. For that condition of indigestion and urinary irritation in which the chief feature is the copious deposit of uric acid and urates, alkaline remedies, such as the bicarbonate of soda, or the carbonate, citrate, and acetate of potash, in scruple or half-drachm doses dissolved in three or four ounces of water, given three or four times a day, afford the best and quickest relief; they produce an alkaline condition of the urine, and a complete solution of the deposit for the time. Salts of lithia are of much value. Lime-water and solution of carbonate of lime have the same effect, but in part this appears to be due to the diuretic effect of the salts of lime. Where hepatic congestion and general sluggishness of all the secretions are present, saline as well as alkaline remedies are indicated, and particularly those mineral waters, such as Vichy, Carlsbad, Wiesbaden, &c., which seem to have the power of exciting all the alimentary secretory glands to healthy and increased action. Diaphoretics, especially the warm water or the hot bath, by increasing the elimination of the acid secretion, are useful adjuncts. Caution, however, is required in the frequent repetition of alkaline remedies, lest the condition of the blood itself be modified and deteriorated. A well-chosen, simple diet is above all things important, and especially the avoidance of too much animal food, of rich, sweet, or highly seasoned dishes, and of alcoholic drinks. For the treatment of lithic calculus in the bladder reference should be made to surgical works. *See* Gout; Gravel; and Renal Calculus.

William Cadge.

**URINARY CALCULUS.** A calculus connected with any part of the urinary tract. *See* Calculus; and Renal Calculus.

**URINARY ORGANS, Diseases of.**—Synon.: Fr. *Maladies des Voies Urinaires*; Ger. *Krankheiten des Harnapparats.*

In accordance with the plan adopted in other

corresponding articles, it is intended here merely to discuss briefly the diseases of the urinary organs from a general point of view. These organs include:—1. The kidneys, with the infundibula and pelves. 2. The ureters. 3. The bladder. 4. The urethra. The particular diseases of each part of the urinary apparatus will be found treated of under these several headings, and in certain special articles, to which the reader is referred.

Summary of Diseases.—The primary division of diseases into *functional* and *organic* must be recognised in connection with the urinary organs.

I. Functional.—The following disorders may be included under this group:—1. The excretory function of the kidneys is influenced and often disturbed by various conditions, physiological or pathological, quite independent of any obvious local morbid change. Hence the urine is modified in different ways and degrees, as regards its quantity or quality. This may depend, for instance, upon some general condition, such as fever or gout; upon causes originating in the nervous system; upon digestive disorders; or upon special diseases, such as diabetes. 2. The muscular structures in certain parts of the urinary apparatus are liable to be affected, and this applies practically to the bladder and urethra. The bladder is subject to undue irritability, spasm, or paralysis, the last being especially important in connection with disease of the spinal cord. The urethra is not uncommonly the seat of spasm, giving rise to more or less spasmodic stricture, and consequent retention of urine. 3. It is believed by some authorities that the kidneys or bladder may be affected with neuralgic pains, without any local mischief to account for them.

II. Organic.—The numerous affections of the urinary apparatus belonging to this division may be thus classified:—

1. *Injuries* of different kinds, under which would be included, not only those of traumatic origin, but also ruptures or perforations due to disease.

2. Conditions affecting the *circulation*, namely: *a*. Acute or chronic congestion. *b*. Embolism. *c*. Hæmorrhage. The first two are only met with in the kidneys, but hæmorrhage may occur from any part of the urinary organs.

3. *Acute Inflammatory Diseases.*—These are of different kinds, and comprise the following subdivisions:—*a*. Acute Bright's disease, involving the kidney-substance. *b*. Suppurative inflammation of the kidney, ending in renal abscess. *c*. Inflammation of the mucous membrane. The urinary mucous tract may be involved throughout, but usually only a limited portion is affected, and thus we have the different complaints known as *pyelitis*, or inflammation of the pelvis of the kidney; inflammation of the ureter, rarely existing alone; *cystitis*, or inflammation of the bladder; and *urethritis*, or inflammation of the urethra, the common form of which is gonorrhœa. This mucous inflammation often leads to a purulent discharge, and may terminate in ulceration or gangrene. *d*. Inflammation around the kidney—*perinephritis*; or around the bladder—*pericystitis*.

4. *Chronic Inflammatory Diseases.*—These may remain after the acute forms, or they are chronic from the outset. Practically they include generally certain forms only of Bright's disease, and mucous inflammations.

5. *Malpositions and Malformations.*—These abnormal conditions may be of considerable importance in connection with the urinary organs, being either congenital or acquired, and varying in their nature.

6. *Hypertrophy and Atrophy.*—The morbid changes of this kind belong to two main classes, according as they affect the kidney-substance, or the walls of the duct or bladder. Atrophy of the kidney is either acute or chronic, the latter being in almost all cases a form of chronic Bright's disease, but it may be congenital or due to compression.

7. *Obstruction, Dilatation, and Accumulations.* Obstruction may be due to different causes, and localised at either of the orifices, or at any point in the course of the ureter or urethra. As a consequence of such obstruction, and occasionally from other causes, dilatation occurs, affecting either the pelvis and infundibula of the kidney, the ureter, the bladder, or the urethra, according to its seat; the entire tract may be thus implicated. Accumulations also follow, either of urine, pus, or other materials, and these may become very serious. Hydronephrosis and pyonephrosis are forms of disease in which urine or pus thus accumulates in the pelvis of the kidney. Retention of urine in the bladder is of common occurrence, arising from various causes. Cystic disease of the kidney may be mentioned under this head, as in some instances, at any rate, it probably arises from limited dilatations of the renal tubules.

8. *New Growths and Degenerations.*—Cancer may involve any or every part of the urinary apparatus. Non-malignant growths are met with in exceptional cases. Tubercular disease is an important and serious malady in connection with the urinary organs. The kidneys are liable to albuminoid disease, and to fatty degeneration. Syphilitic growths may also be found in them.

9. *Gravel, Calculi, and Foreign Bodies.*—The formation of calculi of different kinds, and the morbid conditions resulting therefrom, are of peculiar importance in relation to the urinary organs, and a large proportion of cases in actual practice belong to this group. It may also be mentioned here that foreign bodies are sometimes found in the bladder and urethra.

10. *Parasites.*—Certain parasites are particularly associated with the urinary organs, and especially the Strongylus gigas and the Bilharzia hæmatobia. Hydatid disease is met with in rare instances.

Ætiology and Pathology.—It would be quite out of place here to discuss the ætiology and pathology of some of the morbid conditions that have been mentioned, such as urinary calculus, or cystic disease of the kidney, which are fully considered in special articles. All that can be done is to point out in a general way the principal morbific causes which act upon the urinary organs, and the modes of origin of its disease. 1. These organs are much more

liable to injury than most others. This may not only come directly from without, but may also be inflicted by articles introduced into the urethra or bladder, by surgical operations, or by calculi. 2. Certain morbid conditions are congenital, being the result of imperfect development, or of intra-uterine disease. 3. Exposure to cold or wet undoubtedly originates serious renal disease in some cases, such, for instance, as Bright's disease; and it is also supposed to give rise in other instances to less serious complaints in connection with the urinary organs, such as congestion, or some form of mucous inflammation. This cause probably acts by interfering with the cutaneous excretion, and inducing internal congestion. It may also be remarked that want of cleanliness of the skin is capable of assisting in developing renal disease. 4. Affections of the urinary organs are of frequent occurrence in connection with certain acute febrile diseases, either as essential parts of these diseases, or as complications or sequelæ. Scarlatina and pyæmia demand special mention in this connection. 5. Abnormal conditions of the urine when first excreted, or the presence of certain materials in the kidney which this organ cannot properly excrete, are prolific causes of urinary affections. These abnormal conditions and materials may originate in a variety of remote causes, and they are well exemplified by the effects of certain medicines, alcohol, excessive acidity of the urine, diabetic urine, and gout. Such causes may induce congestion, inflammation, chronic renal changes, or calculi. 6. The urinary organs may be implicated as part of some general or constitutional disease, as in cancer, tuberculosis, or albuminoid disease. 7. Certain parasites specially lodge in these organs, as has been already mentioned. 8. The urinary organs may be affected, owing to some neighbouring disease. For instance, a tumour may compress the ureter or bladder, or obstruct the renal vein; or the structures may be involved by extension. 9. Cardiac diseases which impede the venous circulation, not only cause venous congestion of the renal organs, but in time give rise to serious organic changes. 10. The cause of urinary disease may be in the nervous system. Thus may arise a form of acute congestion of the kidneys; and the paralysis of the bladder, which spinal disease so often produces, is liable to be followed by cystitis and its consequences. 11. One specific disease is associated with the urethra, namely, gonorrhœa; and its effects often extend to the bladder, or even higher up along the urinary tract. 12. It is important to notice that the different parts of the urinary apparatus have an intimate relation to each other from an ætiological point of view. For instance, it is believed that one kidney may become hypertrophied, if the other should be destroyed by disease. Or a morbid condition may extend directly from one part of the urinary organs to another. Again, urine which undergoes certain changes after its formation, is liable to cause mischief. There are other relations which probably exist between the different portions of the urinary apparatus, which are discussed elsewhere. *See* Surgical Kidney.

Clinical Investigation and Signs.—Without entering into details, the symptoms and signs which may be associated with urinary diseases can be summarised in the following way, and this summary will indicate the course to be adopted in their investigation. 1. Painful sensations, with or without tenderness, may be referred to the region of the kidneys, perhaps to the ureter, to the bladder, or to the urethra, when these are respectively the seat of mischief. Moreover, disease in one part may be accompanied with sympathetic sensations in some other part; or in certain conditions there may be pain along the spermatic cord to the testis, with retraction of this organ. Other sensations are complained of in many instances, such as itching or tickling at the end of the penis, heat or burning along the urethra, heaviness and weight in the lumbar region, or fulness of the bladder. These feelings are often modified by various causes. 2. The sensations connected with micturition are of special significance, such as a frequent inclination to pass water, a sudden and urgent desire, or strangury. 3. The act of micturition itself is often affected. It may be too frequent or infrequent; difficult, even to complete retention—*dysuria*; or performed involuntarily—*incontinence*. The stream of urine is altered in size or shape in some conditions (*see* Micturition, Disorders of). 4. The urine itself affords signs of great importance in relation to diseases of the urinary apparatus, in regard to its quantity, physical characters, chemical composition, and microscopic appearances. Indeed, it very often happens that the urine alone affords any evidence of urinary disease. At the same time it must, of course, be borne in mind that this excretion is modified by many other conditions, the urinary organs being quite healthy. This subject is fully treated of elsewhere (*see* Urine, Morbid Conditions of). 5. Urinary diseases often produce important effects upon the blood or general system, as well as upon other organs. Hence arise renal dropsy; the phenomena of uræmia, septicæmia, or the typhoid condition in some forms of disease; collapse sometimes; and morbid conditions affecting the heart and vessels, or certain structures in the eye. These morbid changes may be evidenced by more or less marked symptoms. Moreover, enlargement of the kidney may affect neighbouring structures. 6. Physical examination is of essential value in the investigation of many urinary affections, and in carrying this out the aid of a skilful surgeon is often of the first consequence. The local examination is directed to the determination and investigation of enlargements or tumours of the kidneys; conditions of the bladder, especially retention of urine, and the presence of calculi and growths; and morbid states affecting the urethra, such as enlarged prostate, stricture, or the lodgment of a calculus. Physical examination also reveals the changes in other structures already alluded to.

These are the main points which can be usefully discussed from a general point of view with reference to urinary diseases. For their diagnosis, prognosis, and treatment, as well as for more complete details on the various matters alluded to, reference must be made to the different appropriate articles, especially to those which deal with the affections of the several

parts of the urinary apparatus. *See* BLADDER, Diseases of; BRIGHT'S DISEASE; KIDNEYS, Diseases of; RENAL CALCULUS; SURGICAL KIDNEY; URETER, Diseases of, &c.

FREDERICK T. ROBERTS.

**URINE, Incontinence of.**—The involuntary discharge of urine from the bladder, the patient being either unable to retain it, or unaware of its escape. *See* MICTURITION, Disorders of.

**URINE, Morbid Conditions of.**—SYNON.: Fr. *Maladies de l'Urine*; Ger. *Harnkrankheiten*.

INTRODUCTION.—The urine is the excretion by which the products of nitrogenous waste are eliminated from the body. Alterations in its characters give valuable information regarding tissue-change in the body, and may indicate the presence of disease which would otherwise remain undetected. They therefore require detailed attention. Before entering, however, upon the discussion of the morbid conditions of the urine, it will be well to describe briefly its characters and mode of secretion in health.

In reptiles and birds the waste nitrogenous products of the body are excreted as urates; and the urine is solid. In amphibia and mammals they are chiefly excreted as urea, and the urine is liquid.

Human urine is a clear liquid, of a yellow colour, acid reaction, peculiar odour, and saline taste. It consists essentially of a watery solution of urea, extractive and colouring matters, and salts. Its average specific gravity is about 1,020, but this varies according to the proportion of solids it contains.

**Secretion of Urine.** — Until lately, the theory of Ludwig regarding the secretion of urine was the prevalent one. He believed it to be a process of filtration of water and salts from the vessels in the glomeruli, and that these were partly reabsorbed in the tubules by the cells lining them. But it has been shown by Heidenhain that the cells of the tubules also play an active part in excreting, inasmuch as sulphate of indigo injected into the blood does not colour the glomeruli, but colours the cells of the tubules. The process of secretion of urine may therefore be looked upon as consisting of two parts—first, the filtration of water, and probably of a small quantity of salts, which takes place under pressure from the vessels of the glomeruli; and secondly, the excretion of urea and other solid constituents by the epithelial lining of the tubules. The water which exudes from the glomeruli dissolves and removes the substances excreted by the tubules, and is very possibly also to some extent reabsorbed in its passage. The higher the tension of the blood in the glomerular vessels, the more rapid is the secretion of urine; or, to put it more exactly, the greater the difference is between the tension of the blood in the blood-vessels and the fluid in the tubules, the more rapid is the secretion of urine. The secretion may therefore be increased either by raising the pressure in the vessels, or by diminishing that in the tubules; and, *vice versâ*, it may be diminished by lessening the blood-pressure in the glomeruli, or by raising the pressure of the urine in the tubules. The blood-pressure may be raised either generally throughout the body, or locally by dilatation of the renal arteries. These arteries have considerable power of contraction, so much so that they can lessen the pressure in the glomeruli even when it is raised throughout the body generally. The blood-pressure may be raised in the body generally by the contraction of the arterioles from exposure to cold, by mental excitement, by the influence of food, or by the action of certain drugs, such as digitalis. It may be lowered by shock, by exposure to external warmth, or by rise of the bodily temperature, as in fever. It seems probable, from experiments made by the writer and Mr. Power, that the arterial tension in the glomeruli may be locally diminished even when the general blood-pressure is increased, by the action of digitalis, which, while causing contraction of the vessels generally, affects those of the kidney more especially, and thus, by their contraction, lessens the blood-supply to these organs. The vessels of the kidney are controlled by the medulla oblongata; and when this is stimulated, either directly by a galvanic current or by asphyxial blood, or reflexly by irritation of a sensory nerve, the renal vessels contract. Dr. Roy has shown that they are also very sensitive to slight changes in the chemical constitution of the blood, water or urea causing slight contraction, followed by greater and longer dilatation. Digitalis does so also; but the contraction is much longer. Common salt, nitrate of soda, and acetate of potash cause dilatation without previous contraction. They act upon the vessels even when the nerves are cut, and therefore they must affect them either directly, or through some local vaso-motor nervous apparatus.

By experiments on the kidneys of amphibia, which have a separate vascular supply to the glomeruli and tubules, Nussbaum has found that sugar, peptones, and albumen are excreted through the glomeruli; but that urea is passed out through the epithelium of the tubules, and in passing out causes increased secretion of water from them.

CHARACTERS OF URINE.—**1. Transparency.** Healthy urine is clear when passed, but after standing some time a light flocculent precipitate falls. This consists of mucus and epithelial cells from the urinary passages. A hummocky, white, and sharply defined upper surface indicates the presence of crystals of oxalate of lime in the cloud. Small white flocculi of this size and shape, looking somewhat like small worms, may occur suspended in the freshly-passed urine of persons who have suffered from gonorrhœa or prostatitis some time previously. On microscopic examination they are found to consist of aggregations of leucocytes. The writer has found the presence of these flocculi useful in diagnosing gonorrhœal rheumatism where no history of gonorrhœa was given by the patient.

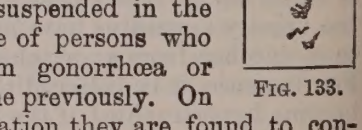

FIG. 133.

Urine which is clear when passed may afterwards deposit sediments of urates or phosphates. These are distinguished from each other by warming the urine. The urates dissolve and the urine becomes clear; but the phosphates are not dissolved, and the urine is rendered more turbid by

the heat. On the addition of a few drops of acid the phosphates dissolve readily, and the urine becomes clear. When the urine is concentrated and contains much urates, it may become turbid almost immediately from their deposition, if it is passed into a cold vessel.

Turbidity of the urine as it is passed is generally, however, due to earthy phosphates, mucus, pus, or blood. The whitish or light colour of the turbidity due to the first three causes distinguishes it from turbidity due to blood. The addition of a few drops of acetic acid causes the turbidity due to phosphates to disappear, while it does not remove that due to mucus or pus. Turbidity due to pus is distinguished from that due to mucus by the presence of albumin. The albumin may be recognised by adding a drop or two of a clear solution of ferrocyanide of potassium to the urine previously acidulated by acetic acid. If the turbidity is not increased it is due to mucus. If it is increased it may be due to pus, or to mucus in albuminous urine. In this case let the urine stand until the sediment has deposited, pour off the supernatant liquid, add a small piece of caustic potash to the sediment, and stir it for some minutes with a glass rod. If it is due to pus it will become more transparent and tough, forming a thick mucilaginous fluid, which flows with difficulty when the quantity of pus is small. When there is much pus it will form a thick, glassy coherent lump. If due to mucus it will not become thick and coherent. If due to blood the addition of a drop of tincture of guaiacum and twenty drops or more of ozonic ether will give a blue colour.

2. **Colour.**—The colour of urine varies from an almost imperceptible yellow to a dark brown or almost a black. Four degrees are usually distinguished—*pale*, *normal*, *high-coloured*, and *dark*. It is usually understood that the description applies to urine seen in a white chamber-pot, from one-third to one-half filled, or more exactly, as suggested by Vogel, in a cylindrical glass about three and a half or four inches in diameter. *Pale* urines are those which under such circumstances vary from an almost complete absence of colour, so that they are indistinguishable from water, except when seen in thick layers, up to a straw-yellow colour. *Normal* urines are those which have a golden yellow up to an orange-yellow colour. *High-coloured* have a reddish-yellow to a red colour; and *dark* urines have a deep red-brown or blackish colour.

These variations in the colour of urine are to a great extent due to the proportion of water in which the urinary pigments are dissolved. Watery urine is pale, and concentrated urine is high-coloured. It is probable that they also depend on variations in the nature of the pigments chiefly present. Sometimes they are due to an admixture of foreign colouring matter, such as bile or blood.

*Clinical Import.*—Pale urine occurs when secretion is rapid, and the urine is consequently dilute, as after copious draughts of liquid or exposure to cold. It is found also in cases of granular kidney, anæmia, chlorosis, diabetes mellitus and insipidus, and after hysterical fits, asthma, or other forms of nervous excitement.

High-coloured urine occurs when the secretion is diminished by profuse perspiration; and also in disorders of the liver, and febrile conditions. The colour of the urine is generally deeper after food, and the urine may be high-coloured after a large meal in healthy persons.

Dark urine generally owes its colour to bile, hæmoglobin, or blood. Bile gives it various tints of brown or green; hæmoglobin or blood imparts a smoky, blood-red, or coffee colour. When blood is mixed with much pus in a strongly alkaline urine, the colour may be greenish-brown. Carbolic acid or creasote extensively used, either externally or internally, renders the urine blackish or black. In cases of melanotic cancer the urine, although of a normal colour when voided, may become black after standing; and this darkening is much accelerated by the addition of nitric acid or other oxidising agents.

3. **Quantity.**—The quantity of urine passed in twenty-four hours varies very greatly. The average may be roughly stated to be about fifty ounces, and the ordinary variation is about one-fifth of the quantity above or below the normal. The quantity is usually increased by anything which raises, and lessened by anything which diminishes, the arterial tension. Thus, cold and nervous excitement will increase it, while warmth and quiet usually diminish it. The quantity passed during the waking hours is much greater than during the hours of sleep; and the fact that the person has to rise during the night one or more times to pass water awakens suspicion of renal disease, or of excessive secretion.

Although temporary conditions may cause the amount of urine passed in one day to differ much from that of another, yet in healthy people it usually equalizes itself in two or three days, unless there be constant disturbing influences, such as persistent cold.

*Clinical Import.*—(*a*) A persistent *increase* in the quantity of urine may indicate diabetes mellitus, polyuria, waxy kidney, or granular kidney. These are diagnosed by the presence of sugar in diabetes; by the entire absence of both sugar and albumin in polyuria; by the presence of considerable albumin in waxy kidney; and by the presence of albumin—though only in small quantity, and of high arterial tension, in granular kidney. The conditions in which temporary increase in the quantity of urine occurs are exposure to cold, nervous excitement, hysterical fits, copious drinking, the use of diuretic medicines or articles of food containing tartrates or citrates, and the consumption of certain forms of wine and alcohol, as hock and gin.

(*b*) A quantity of urine *below the average* may be due to habit, leading the individual to drink little fluid; or to habitual exposure to heat, leading to excessive perspiration. A diminution in quantity also occurs in acute inflammation of the renal glomeruli or tubules; in subacute exacerbations of chronic inflammatory conditions; and in certain disordered states of the nervous system. It also occurs in cases of granular kidney approaching a fatal termination, and is then a sign of grave import.

4. **Specific Gravity.**— This is most easily ascertained by the form of areometer which

is called a *urinometer*. In using this instrument care should be taken that it is clean and dry before it is put into the urine, and that it does not touch the sides of the vessel. The surface of the fluid forms a meniscus, and the graduation on the stem of the instrument should be read off at the lower edge of the meniscus with the eye on a level with it. When there is not sufficient urine to take the specific gravity, it should be diluted with one, two, or as many times as may be necessary, volumes of water, and the specific gravity taken. The decimal figures of the specific gravity thus found are then multiplied by the number of times the urine has been diluted, in order to get the true specific gravity. Thus if the urine has been diluted by adding four times its own volume of water to it, its bulk is increased to five times that of the original urine. If the specific gravity of the diluted urine is 1002, the specific gravity of the original urine is $1{\cdot}000 + ({\cdot}002 \times 5) = 1{\cdot}010$. The urinometers give the specific gravity at 60° Fahr.; and at any temperatures above this they indicate a lower specific gravity, and at temperatures below a higher specific gravity, than the true one.

The specific gravity of the urine depends on the proportion of solid matters which it holds in solution. The amount of water in the urine fluctuates much more than the solids, and therefore the specific gravity varies also. It is less when the urine is watery, and greater when it is concentrated. The average specific gravity is about 1020, but it may vary in health between 1010 and 1025, or even beyond these limits. It varies in the same person at different times of the day, and in different portions of urine passed at the same time. As the urine is secreted and accumulates gradually in the bladder, it becomes arranged in layers according to its specific gravity, the heaviest layers being lowest. If the person remains quiet, so as not to mix the layers, and passes the urine in successive portions into different glasses, their specific gravity may be found to differ.

The specific gravity is diminished during fasting, but is increased after meals, on account of the greater excretion of solids which then occurs. It is diminished when the secretion is quickened, or rendered more abundant and watery by drinking copiously of fluids, by exposure to cold, by mental excitement, or by the use of diuretics. It is increased when the urine is concentrated by abstinence from fluids; by profuse perspiration, which carries off much water by the skin; and by long retention in the bladder, which allows some of the water to be re-absorbed. The variations in specific gravity due to the causes just mentioned are transitory, and are generally succeeded by variations in an opposite direction; so that the specific gravity of the entire urine passed during twenty-four hours may be little altered.

*Clinical Import.*—A persistently high specific gravity generally indicates diabetes mellitus, or azoturia. It also occurs at the beginning of acute febrile diseases; and in acute nephritis with hæmaturia.

The specific gravity is increased by the presence of albumin alone, as well as by blood. It is sometimes thought that the mere presence of albumin diminishes the specific gravity of the urine, but this is an error. It is quite true that in certain cases of albuminuria the specific gravity is diminished, but this is due to the absence of other ingredients, and not to the presence of albumin. The writer has found experimentally that the addition of serum-albumin to the urine increases its specific gravity.

An abnormally low specific gravity may indicate contracted or amyloid kidney, diabetes insipidus, or hysteria.

5. **Reaction.**—Fresh normal urine is generally acid, but when passed after a meal it may be neutral or even alkaline, and sometimes, though rarely, the mixed urine of twenty-four hours may present a similar reaction. Sometimes the reaction is amphoteric or amphogenous, that is, red litmus paper is rendered blue, and blue litmus paper is turned red. The acidity of the urine is chiefly due to acid phosphates, and in part also to free organic acids, such as lactic and hippuric. The amphoteric reaction is probably due to the presence of basic and acid phosphates together. The acidity is less when acid is being secreted by the stomach or skin during digestion or profuse perspiration. It is diminished by vegetable diet, and by alkalies or their salts with vegetable acids. It is diminished in anæmia and chlorosis; and in melancholia or paralysis the reaction may be neutral or alkaline from potassium or sodium carbonates. It is increased by a flesh or a milk diet, by muscular exercise, by drinking, and by acids; and also in fever and diabetes.

When urine is passed with proper precautions into a vessel which has been previously heated, so as to destroy all germs, it may be kept unchanged for years.

Usually it becomes altered quickly, its reaction becoming, first, more strongly acid, then less acid, and finally alkaline. These changes are due to fermentation, which leads first to the formation of acid phosphates, and of lactic and acetic acids, from the extractive matters of the urine, with deposition of uric acid. This increase of acidity is not constant, and deposition of uric acid may occur simply from chemical reaction between urates and acid phosphates. After a varying period the urea becomes decomposed, and carbonate of ammonia is formed, which gives to the urine an ammoniacal odour and alkaline reaction, and causes the precipitation of urate of ammonia, ammonio-magnesian phosphate, calcium phosphate, and calcium carbonate.

The acid fermentation, when present, is probably due to an organism similar to yeast. The alkaline fermentation is probably caused in great measure by bacteria, but it may be induced also by a non-organised ferment, which has been isolated from ammoniacal urine. This ferment appears to be generally produced by bacteria, but it may be produced also, under certain circumstances, by the mucus-corpuscles and epithelial cells in the bladder. Fresh urine inoculated with bacteria from decomposing urine undergoes very rapid change, and the same is the case with the urine inside the bladder when it is inoculated by means of dirty catheters. But similar changes may occur in the bladder in cases of cystitis, even when no instruments have

been introduced, and the ferment in these cases appears to be formed by the mucus or epithelium. In order to distinguish whether the alkalinity of the urine depends on ammonia or on fixed alkalies, the red litmus paper must be dried after being dipped in it. If the alkalinity is due to ammonia the blueness of the paper which it produced will disappear, and the paper return to its original red colour; but the blue will remain if the alkalinity is due to fixed alkalies.

Solid Constituents.—The solid constituents of the urine are the ashes of the body, and their quantity varies with the amount of food consumed, and the amount of waste in the tissues of the body itself. Their quality depends on the nature of the nutritive processes and of the tissue-change going on in the body: and it thus forms a useful indication of the healthy or diseased nature of the tissue-change and nutritive processes. Some solids are constantly present, although in varying quantities, in healthy urine; others are only occasionally present; and others again never occur in health, so that their presence is a sign of disease. Those present in health are (1) *nitrogenous substances*—urea, uric acid, allantoin, oxaluric acid, xanthin, kreatinin, sulphocyanic acid, Baumstark's body, and perhaps guanin; (2) *ferments*—pepsin, nephrozymose or ptyalin; (3) *salts*—chiefly chlorides, sulphates, and phosphates of sodium, potassium, ammonium, calcium, and magnesium, sodium chloride being the most abundant; (4) *acids*—oxalic, lactic, and glycero-phosphoric acids, possibly present in combination, or partly free; sulphuric acid in two forms, simply combined with bases as sulphates, or united with other substances so as to form ether-sulphuric acids of phenol, kresol, brenzcatechin, indoxyl, scatoxyl, &c.; and (5) *pigments*, and pigment-yielding bodies or chromogens.

*Abnormal constituents* include albumins, blood, hæmoglobin, methæmoglobin, bile-pigments, bile-acids, grape and milk sugar, leucin and tyrosin, lecithin, cystin, fat, &c.

The *quantity* of solid constituents is determined exactly by weighing the dried residue of a given quantity of urine. It may also be ascertained approximately by multiplying the last two figures of the specific gravity by 2·33. This gives the amount per thousand, and from this the total quantity is reckoned. Thus, if a man passes 1,560 cub. cent. of urine daily, which when mixed has a specific gravity of 1,022, then $22 \times 2{\cdot}33 = 51{\cdot}26$ and $1000 : 1560 :: 51{\cdot}26 : 79{\cdot}96$ grammes of solids per diem.

The most important constituents must now be described.

1. **Urea** ($CON_2H_4$).—This is by far the largest and most important of the organic constituents of urine, as 70 or 80 per cent. of the entire nitrogen excreted appears as urea. The quantity of urea passed *per diem* by a healthy man is on an average 33·18 grammes or 512·4 grains. Urea may be regarded as the ash of the nitrogenous substances, whether food or tissues, which have undergone combustion in the body, and therefore its quantity fluctuates greatly according to the amount of nitrogenous food consumed, and also according to the rapidity of tissue-change. The variations due to the food are so great, however, that unless the amount of nitrogen in the food consumed be kept rigidly the same from day to day, or food be altogether withheld, they mask the variations due to tissue-change. Hence most of the earlier experiments on the influence of drugs, exercise, &c., on tissue-change, as determined from the excretion of urea, are untrustworthy.

The quantity of urea varies with age, sex, country, and other circumstances; but most of these variations are easily accounted for by the proportion of nitrogenous food taken by children and adults, men and women, English, French, or Germans respectively. Muscular exercise up to a certain point does not increase it, but when excessive it appears to do so; the explanation probably being that in ordinary exercise no destruction of the nitrogenous constituents of the muscle occurs, the energy being supplied by their non-nitrogenous elements, but that when the exercise is too severe and prolonged, the albuminous constituents of the muscles themselves become partially destroyed.

Nitrogenous food, such as meat of all sorts, eggs, and gelatin or substances which yield it, increase the excretion of urea in proportion to the quantity of this sort of food taken. There seems to be a limit, however, beyond which the excretory powers of the kidney will not go, and when this limit is reached, nature saves the organism by diarrhœa, which carries off the excess of nitrogenous food. The addition of fat alone to an abundant diet of meat rather increases the excretion of urea; but when farinaceous food is added to such a diet, the urea is rather diminished. Farinaceous food and fats given to an animal deprived altogether of nitrogenous food, cause it to excrete less urea than if it were totally deprived of food. The addition of farinaceous food and fat therefore appears to lessen the destruction of the nitrogenous tissues themselves.

When much water is drunk, the absolute amount of urea excreted in twenty-four hours is considerably increased, although, the urine being so much more abundant, the percentage of urea is lessened. The increase in urea is said to be greater when the water is drunk during the meal, than when it is drunk after digestion has taken place.

Table and other salts increase the quantity of urea, even when no more water is drunk, and also increase the quantity of water, probably by causing part of the water to be eliminated through the kidneys, which would otherwise have passed off through the lungs or skin.

Moderate warmth appears to diminish the excretion of urea, probably by increasing the secretion of sweat; but when an animal is kept for a length of time at a high temperature, a condition of fever appears, and the excretion of urea is greatly increased.

*Quantitative Estimation.*—Formerly urea was usually estimated by Liebig's method of titration with nitrate of mercury; but the mode now usually adopted, as being at once accurate and easy, is the hypobromite process. This method is due to Davy, who used hypochlorite of soda, and this was afterwards modified by Hüfner, who introduced the hypobromite in place of

hypochlorite. This method depends on the fact that urea, in contact with alkaline hypobromites or hypochlorites, is decomposed, and gives off nitrogen, from the amount of which the quantity of urea decomposed can be readily estimated. Various modifications in the method of applying the process have been introduced, the one in most common use perhaps being that of Russell and West.

The apparatus consists of a tube in which the urine is allowed to mix with a hypobromite solution, and a pneumatic trough, with a measuring tube, in which to collect the evolved gas. The measuring tube is graduated to give the percentage of urea. Another apparatus is that of Dupré, in which the urine and hypobromite solution are mixed in a bottle connected with the measuring tube by an india-rubber tube. Both of these are well adapted for clinical use. In each of them 5 cc. of urine is mixed with four or five times its bulk of the hypobromite solution. This solution is prepared by dissolving 100 parts of caustic soda in 250 of water, and adding, when cold, 25 parts of bromine. The solution does not keep, and is best made by having the soda solution of a proper strength, and adding the required quantity of bromine at each analysis.

The readiness with which crystals of nitrate of urea form on the addition of nitric acid to a solution containing it, affords a means of estimating roughly the quantity of urea present in urine. These crystals do not form in normal urine on the simple addition of nitric acid, but do so in urine containing great excess of urea. Thus, if equal parts of strong nitric acid and such urine—say, half a drachm of each—be mixed in a test-tube, and this be placed in cold water, the crystals will soon make their appearance. Another form of test is easily applied on an object-glass. One end of a small piece of thread is put into a drop of urine on the glass; the drop, and the half of the thread are then protected by a thin covering-glass; and the other end of the thread is moistened with nitric acid. The whole is then put under the microscope, and hexagonal plates of nitrate of urea are seen forming at each side of the thread when there is great excess of urea. If the urine contains the normal, or less than the normal, amount of urea, it must be more or less evaporated by gently heating over a spirit-lamp before the crystals form; and from the extent to which this is necessary a rough estimate of the deficiency of urea may be formed.

*Clinical Import.*—When the percentage of urea is much above 2 per cent. it generally indicates that the patient is either feverish, or has been perspiring profusely, or that the quantity of water he drinks is too small to ensure the ready elimination of the products of nitrogenous waste. In such cases, if the thermometer does not indicate the presence of fever, or if the patient has not been perspiring profusely, he should be advised to drink more water, in order to prevent the possible occurrence of rheumatic or gouty affections. A small percentage of urea is of much graver significance. It may be due to copious drinking, exposure to cold, or to mental excitement; but when it occurs independently of these causes in elderly persons, it very commonly indicates the presence of contracting kidney.

The name *azoturia* has been given to a condition in which the excretion of urea is excessive, in proportion to the weight of the body. In some persons excessive excretion of urea is associated with increased secretion of water, so that the proportion of urea remains normal. In others the water is not increased, and therefore the urea excreted is not only increased in absolute quantity *per diem*, but its proportion in the urine is greater than normal, so that such urine at once gives crystals of nitrate of urea on the addition of nitric acid. Excessive excretion of urea, both absolute and relative to the amount of urine, may occur for a time in perfectly healthy persons, without any abnormal symptom whatever. In others, however, such an excess of urea is associated with gastro-intestinal derangement and nervous symptoms, the patient complaining of acidity and flatulence, but not of thirst or excessive appetite. There is languor, fatigue after slight exertion, bodily or mental, nervousness, restlessness at night, dull pain in the back, and sometimes irritation at the neck of the bladder, with constant desire to pass water. It is probable that in some individuals the nitrogenous tissue-change goes on more rapidly than in others, and that they consequently require a larger proportion of nitrogenous constituents in their food, to enable them to do the same amount of work; and that when indigestion occurs in such persons, the nitrogenous products of imperfect digestion or tissue-waste, acting as nervous and muscular poisons, lead to the symptoms of which they complain. In diabetes there is increased excretion of urea, from the greater amount of food taken by the patients; and it has been supposed by Prout that cases of azoturia might pass into diabetes.

The *treatment* consists in ordering nutritious diet, with a large proportion of farinaceous constituents; moderate exercise; avoidance of fatigue, mental or bodily; purgatives; alteratives; and opium.

2. **Uric Acid.**—($C_5H_4N_4O_3$).—When pure, uric acid forms white crystals, very sparingly soluble in water. It does not exist free in the healthy urine, but is combined with potash, soda, and ammonia. From these it may be separated by the addition of an acid, or by acid fermentation in the urine after it has been passed, as already described.

As deposited from the urine, uric acid is nearly always coloured. It may be deposited in scattered brown specks, or as a dense deposit of red sand, resembling red pepper in appearance; or it may form a thin film on the surface of the urine. The crystalline character of the deposit can generally, though not always, be recognised by the naked eye. On microscopic examination the crystals usually present a somewhat lozenge-shaped form. This form is modified by rounding and by aggregation. When the angles are rounded off, spindle-shaped, ovoid, and barrel-shaped forms are produced. Sometimes they are elongated, so as to produce a rod; and the aggregation of the lozenge, ovoid, and rod-like forms produces stars and spikes, varying considerably in appearance. Sometimes, also, they appear

like dumb-bells (*see* MICROSCOPE IN MEDICINE). The crystals of uric acid are distinguished by their reddish or brown colour, as well as by their peculiar appearance. They dissolve readily in caustic soda or potash, and separate again on the addition of hydrochloric acid. The chemical test for uric acid is generally known by the name of the murexide-test. It distinguishes uric acid and urates from other urinary sediments, but it will not distinguish free uric acid from uric acid in combination. The mode of applying it is to warm the sediment in a porcelain capsule, with a few drops of nitric acid and a little water, and to evaporate it carefully, almost to dryness. It is then moistened by a glass rod with diluted ammonia, when a fine purple red colour appears, which, on the addition of a drop of caustic potash, passes into a purplish blue.

*Quantitative Estimation.*—Uric acid is estimated quantitatively by mixing the urine with $\frac{1}{20}$th of its bulk of hydrochloric acid, and setting it aside in a cool place for twenty-four hours. The deposit of uric acid is then collected on a filter, washed with the least possible quantity of water, dried, and weighed; the weight of the filter alone having been previously ascertained. As the weighing is troublesome and difficult, the quantity of uric acid may be ascertained by carefully washing it off the filter, and boiling it with peroxide of lead in a little water, so as to convert it into carbonic and oxalic acids, allantoin, and urea. The amount of nitrogen in this solution is then estimated by the hypobromite method already described. Uric acid contains one-third of its weight of nitrogen, so that by multiplying the weight of nitrogen evolved by 3, one obtains the quantity of uric acid. Besides this ·0045 gramme is to be added for each 100 cc. of the urine employed.

Another method (Cook's) is to add 3 or 4 drops of caustic soda to 300 or 400 c.c. of urine, and, after the phosphates have subsided, to add to 100 c.c. of the clear liquid about 4 c.c. of a solution (1 in 3) of zinc sulphate, sufficient to make the urine faintly acid. This precipitates the uric acid in the form of insoluble zinc urate. The precipitate is washed on a filter with a saturated solution of zinc urate, and then placed with the filter in the urea apparatus, and the nitrogen estimated by the hypobromite method, as already described. When boiled with liquor potassæ and cupric sulphate, uric acid reduces the latter to cuprous oxide. The writer has seen a case in which the reduction was so great as to lead the patient, who was a medical man, to think that he was suffering from diabetes, and to put himself on an animal diet, by which his condition was of course made worse.

2*a*. **Urates.**—Uric acid occurs in combination with soda, ammonia, and lime; the urate of soda being the most common. The urates, being readily soluble at the temperature of the body, are only deposited on cooling, so that the urine, which was clear when passed, becomes muddy, and a sediment forms, which is commonly coloured like brick-dust, varying in shade, being sometimes almost white and sometimes red. Pale white urates are readily distinguished from phosphates by quickly clearing up when the urine is warmed, while the phosphates do not. Microscopically, the urates of soda and lime are usually amorphous; but sometimes the urate of soda forms globules with projecting spikes, which have caused them to be compared to hedgehogs. The urate of ammonia forms opaque globules, or slender dumb-bells, which are either single or aggregated, so as to form a cross or rosette.

*Clinical Import.*—Deposit of urates occurs readily after any violent exertion or perspiration, or after errors in eating or drinking. People are often frightened by such deposits, but they are of no importance unless they should persist for a length of time. Persistent deposits occur in febrile conditions or deep-seated organic disease. In cirrhosis the urine is sometimes heavily loaded. *See* URIC ACID DIATHESIS.

3. **Oxalate of Lime.**—Oxalate of lime is recognised by the white, hummocky appearance of the top of the mucous cloud in the urine. On microscopical examination, octahedral crystals are seen, presenting the appearance of a folded envelope. It also occurs in colourless dumb-bells. It is distinguished from uric acid by being colourless, and insoluble in alkalies; and from phosphates by being insoluble in acetic acid.

*Clinical Import.*—The occasional occurrence of oxalates is of slight importance, and is usually connected with diet. In hospital practice the writer has noticed that when the patients ate cabbage for dinner, a large proportion of them had oxalates in the urine next morning. Persistent presence of oxalates in the urine has been supposed to be connected with a peculiar diathesis (the oxalic acid diathesis), the symptoms of which are languor, depression, and melancholia. It is most probable that both this and the presence of oxalates in the urine are simply due to imperfect digestion, more especially as they often disappear readily on treatment by nitrohydrochloric acid. *See* OXALIC ACID DIATHESIS.

4. **Phosphates.**—Two kinds of phosphates are found in the urine—phosphate of lime, and ammonio-magnesian or triple phosphate. They are always deposited when the urine becomes alkaline through fermentation; and when feebly acid urine is heated, so that the carbonic acid is driven off, phosphates are precipitated in the form of a cloud, which might be mistaken for albumin, but clears up at once on the addition of a drop of acid. Under the microscope, phosphate of lime is amorphous. The ammonio-magnesian phosphate occurs in rhombic prisms, which are distinguished from oxalate of lime by dissolving readily in acetic acid.

*Quantitative Estimation.*—A rough quantitative estimation of phosphates is made by rendering some urine alkaline with ammonia, and adding an ammonio-magnesian solution to it. A precipitate of ammonio-magnesian phosphate at once occurs if the amount in the urine be normal, but is delayed when the quantity is below normal.

*Clinical Import.*—In persons having little exercise and a good deal of brain-work, the urine may be turbid when passed, from phosphates present in it. This usually passes away when they get more exercise. It may continue

for months, and is of importance only in so far as it renders the patient liable to phosphatic calculus. Such deposits do not indicate increased quantity of phosphates in the urine, but are simply due to diminished acidity. The writer has found the actual quantity of phosphates present in such turbid urines less than in specimens of clear urine from the same individual. The occurrence of stellar crystals of phosphate of lime in quantity in the urine is, according to Roberts, of grave import, indicating serious disease of some kind or other, although a few such crystals may occur in normal urine. The triple phosphate almost invariably occurs in ammoniacal urine, and generally appears after urine, alkaline from any cause, has stood for some time. *See* PHOSPHATIC DIATHESIS.

The quantity of phosphates is increased in febrile disorders, and in diseases of the nerve-centres and bones; it is diminished in Bright's disease, and sometimes in dyspepsia, as well as after the disappearance of febrile conditions.

5. **Sulphates.**—Sulphur appears in the urine, first, as sulphuric acid, free or in conjunction with organic radicals; secondly, as oxidisable sulphur compounds, for example, taurine; and thirdly, as sulphur compounds oxidisable with difficulty. The presence of sulphuric acid in simple combination with bases, or in conjunction with radicals, is tested by adding barium chloride and hydrochloric acid to the urine, when a white precipitate takes place.

*Quantitative Estimation.*—Sulphuric acid is estimated quantitatively by means of strontium, but for the details of the process the reader is referred to text-books. The oxidisable sulphur is estimated by boiling with nitric acid and chlorate of potash, and then determining the quantity of sulphuric acid present, and deducting from the amount thus found the quantity obtained by the first method. The sulphur oxidisable with difficulty is determined by evaporating a measured quantity of urine to dryness, calcining with nitrate of potash, estimating the sulphuric acid, and deducting from these the quantity found by the second method.

*Clinical Import.*—The excretion of sulphur in the urine may be used as a means of diagnosing the condition of the secretion of bile. The more sulphur is excreted in the bile, the less appears in the urine, and *vice versâ*. In biliary colic, due to impediment to the flow of bile through the ducts, the easily oxidisable sulphur has been found by Lepine to be diminished, but the difficultly oxidisable to be increased.

6. **Chlorides.**—Chlorine is present in the urine in combination with ammonia, fixed alkalies, or alkaline earths. The quantity depends chiefly on the amount of salt taken in the food. When this is constant the excretion is also tolerably constant; but if a larger quantity of salt be then regularly taken, the excess may not begin to be excreted until after about three days, when it will again remain constant; and the excretion will be in excess for about three days after the quantity taken has been diminished. The body has, therefore, the power of retaining a quantity of chlorine. In acute inflammatory diseases the chlorides are retained completely, so as to disappear from the urine. The usual test for chloride is the curdy white precipitate given on the addition of nitrate of silver to urine acidulated with nitric acid.

7. **Pigments.**—These have not yet been fully examined, but they appear to exist in the urine both in the state of pigments and pigment-yielding substances or chromogens. The pigment of normal urine is urobilin, which, according to McMunn, is an amorphous yellow-brown pigment. It gives in solution a spectroscopic band at F, disappearing with excess of ammonia or potash, and being again brought into view by acid. When febro-urobilin is present, caustic soda or potash causes the band at F to disappear, and to be replaced by a band nearer the red end of the spectrum.

Normal urobilin appears to be identical with choletelin, the body produced by oxidising acid hæmatin. Normal urine also appears to contain two chromogens, namely, the chromogen of febro-urobilin, and indican. By the addition of oxidising agents to the urine, or by long standing, febro-urobilin may be produced from the chromogen.

The quantity of indican present in normal urine is small. It is tested by mixing the urine with its own bulk of hydrochloric acid, and adding a drop or two of saturated solution of chloride of lime. The indican is thus split up, yielding indigo, which colours the urine blue, and may be removed by shaking with chloroform and allowing it to settle. The supernatant liquid remains of a reddish or purplish colour, from the presence, probably, of indigo-red. There appears to be some difference in the indigo-yielding substance, because occasionally the addition of nitric acid to the urine has no effect, although indican be present, as shown by the test thus given, while on other occasions the writer has found the mere addition of nitric acid render the urine a dark greenish-blue, or almost black, from the immediate separation of indigo, which could be removed by the treatment with chloroform just described.

*Clinical Import.*—Indican appears to be derived from indol, formed by pancreatic digestion. Indol administered subcutaneously increases the indigo in the urine. The indigo is much increased by partial or complete obstruction of the small intestines. It is less affected by affections of the large intestines. It has also been found increased in tabes mesenterica, phthisis, cancer of the stomach, lymphatic growths, cancer of the liver, Addison's disease, and cholera. It is present in large quantity in the urine of persons resident in the tropics. It appears to be increased by turpentine, oil of bitter almonds, and nux vomica.

A chromogen, yielding a purple colour on the addition of nitric acid, is often met with in cases of anæmia where the urine itself is of a very pale colour, but on the addition of nitric acid becomes almost cherry-red.

8. **Albumin.**—The ordinary form of albumin is serum-albumin. Besides this we have paraglobulin, fibrinogen, propeptone, and peptone. For the tests of these substances *see* ALBUMIN, and ALBUMINURIA; and for their clinical import *see* BRIGHT'S DISEASE; and KIDNEYS, Diseases of.

Albuminuria is, however, much more common

than is usually supposed, and has been found to occur in eleven per cent. of apparently healthy persons presenting themselves for assurance. Its significance in such persons has not been completely ascertained, but it has been found that in many such cases, when they are kept under observation, the health goes on deteriorating. Intermittent albuminuria is not infrequent in persons who have been exposed to malaria; and Dr. Quain has observed that intermittent albuminuria in youth is frequently associated with masturbation. In contracting kidney the albumin is usually small in quantity, and may also be completely intermittent, traces of it appearing only in the urine passed after meals, and being entirely absent from urine passed in the morning. This, as the writer has seen, may occur even when the patient is in a very precarious condition, and is already suffering from nephritic asthma. Dr. Mahomed believes that albuminuria may be quite absent in granular disease. Egg-albumin and pro-peptones readily pass through the kidneys (*see* ALBUMINURIA). It has, however, been recently found by Stokvis that if egg-albumin is made to pass through the kidneys for a length of time, the kidneys themselves undergo structural change, glomerular nephritis being induced. These observations confirm the idea, founded on clinical observation by Dr. G. Johnson, that albuminuria with structural kidney-change may be secondary to continued indigestion.

9. **Sugar.**—For the tests and indications of sugar in the urine *see* DIABETES.

10. **Inosite, or Muscle-sugar.**—This occasionally occurs in urine alternately with dextrose. It has no action on polarised light; it does not ferment with yeast; and it does not reduce cupric hydrate, although it causes it to dissolve. It is detected by precipitating the urine first with neutral lead acetate, then with basic acetate, collecting the second precipitate on a filter, suspending it in a little water, and decomposing by hydric sulphide, filtering, and evaporating to a small bulk. A drop is then mixed with nitric acid, and evaporated almost to dryness on platinum foil. A drop of ammonia and one of calcium chloride are next added, and the whole gently evaporated to dryness. A rose-red tinge indicates the presence of inosite.

11. **Blood, Hæmoglobin, Methæmoglobin.** For the tests and indications of these *see* HÆMATURIA; HÆMATINURIA; and HÆMOGLOBIN.

12. **Bile-acids.** *See* JAUNDICE.

13. **Leucin, Tyrosin.** *See* LEUCIN; LIVER, Atrophy of; PHOSPHORUS, Poisoning by; and TYROSIN.

14. **Cystin.** *See* CALCULI.

15. **Abnormal Pigments.**—The chief of these are uroerythrin, giving a red colour to febrile urine, febro-urobilin, and urohæmatin. The nature and relation both of the normal and abnormal urinary pigments and chromogens is not yet fully understood. For bile-pigments *see* JAUNDICE.

*Melanin.*—This black pigment has been found in the fresh urine of patients with melanotic cancer. It appears in the fresh urine as a chromogen, the urine, when freshly passed, being normal in colour; but after standing, or after the addition of oxidising substances, such as nitric acid, the black pigment melanin is formed. This must not be confounded with the black colour from carbolic acid, or with the black colour due to great excess of indigo already described.



*Accidental Pigments.*—Chrysophanic acid may occur, from taking rhubarb or senna. The urine containing it becomes red when it is rendered alkaline by caustic alkali. The colour disappears on the addition of acid.

Santonin colours acid urine yellow or greenish. It is distinguished from biliary pigments by becoming cherry-red and purple on the addition of caustic alkali, this colour disappearing on the addition of acid.

The pigments of bilberries, logwood, beet root, indigo, and gamboge also pass to a certain extent into the urine, and the Cytisus alpinus gives it a grass-green colour. After the use, either external and internal, of carbolic acid, creasote, or phenol, the urine may be greenish-brown or almost black. This is due to products of the oxidation of these substances, chiefly hydrochinon. Sometimes the presence of iodide or bromide of potassium in the urine may render it very dark after the addition of nitric acid, on account of the liberation of free iodine or bromine. These are distinguished by their penetrating odours, and may be separated by treating the urine with chloroform and then gently evaporating. T. LAUDER BRUNTON.

**URINE, Retention of.**—A morbid condition in which there is difficulty or inability to expel the urine from the bladder. *See* MICTURITION, Disorders of.

**URINE, Suppression of.** — SYNON.: Fr. *Suppression de la Urine*; Ger. *Harnverhaltung.* Suppression of the secretion of urine arises under two conditions: first, where there is obstruction in the line of outflow; secondly, where there is some fault in the action of the kidney itself.

1. **Obstructive Suppression.**—This is most commonly a result of impaction of a calculus in the ureter of a patient who has already, from some cause, had one kidney permanently destroyed; or of the presence of a tumour, as of the bladder or uterus, implicating both ureters. A little urine is commonly passed during the progress of such cases. It is generally pale, and of low specific gravity. When suppression is absolute, seven or eight days may elapse before the patient appears to suffer materially, but then occur muscular twitchings, contraction of pupils, weakness of muscles, drowsiness, and in rare cases convulsions. There is neither dropsy nor urinous odour of the breath. The duration of life appears to vary from nine to eleven days.

2. **Non-obstructive Suppression.**—Sometimes in the course of acute inflammatory Bright's disease, complete suppression of urine takes place. It may also occur in the later stages particularly of the inflammatory and cirrhotic forms of Bright's disease; as a consequence of injuries and diseases of the urethra; and in the cold stage of cholera. Doubtless in some of these conditions suppression is due to the nervous system, but the way in which it is brought about is not at present understood.

Treatment.—Next to removal, if possible, of the condition upon which the suppression depends, hot baths or fomentations, and the patient avoidance of active interference with powerful medicines, are among the most important indications. In cases of obstructive suppression, careful kneading of the abdomen may be tried; and this should be persevered with in the most advanced conditions, as cases are on record in which relief has been obtained when the prospect has been utterly unfavourable. In the female, the introduction of a sound into the ureter may be successfully practised. If relief be not obtained, and death be imminent, surgical interference may perhaps be tried.

T. Grainger Stewart.



**URTICARIA** (*urtica*, a nettle).—Synon.: Nettle-rash; Fr. *Urticaire*; Ger. *Nesselausschlag*.

Definition.—A form of erythema, accompanied by a sense of burning and itching, and by a nodulated condition of the skin ascribable to spasm of the muscular structure of the derma.

Ætiology and Pathology.—Like other morbid states of the system urticaria is sometimes excited through the medium of the nervous system, and by irritant substances taken into the stomach (*U. ab ingestis*), such as shell-fish and different articles of diet; in the latter case it is influenced by idiosyncrasy. Some drugs, for instance, copaiba, cubebs, and turpentine, produce eruptions, scarcely distinguishable from urticaria. The complex phenomena known as dyspepsia are a frequent source of the eruption; whilst in some instances an irritable or excitable condition of the nervous system itself may be taken as the cause. In fact, the functions of the nerves are so intimately intermingled with the symptoms of urticaria, that it has been adopted by some authors as a neurotic disorder. And this view of the nature of the affection is corroborated by the occasional concurrence of spasmodic cough and asthma with the development of the rash at the base of the neck. Uterine irritation from pregnancy or other conditions is another common source of urticaria; the nervous sensibility of the integument is so acute that wheals may be produced by the slightest touch, and written characters may be developed at will by the mere act of tracing their outlines on the skin with the point of a pencil. Amongst the local or external causes of urticaria must be mentioned, first, scratching, or some such mechanical irrition, in a few individuals. This has been called *factitious urticaria*. More often this nervous sensibility exists as a temporary condition, accompanying itching affections, such as scabies or eczema, or the presence of pediculi, and thus it comes about that the existence of wheals (urticaria) produced by scratching is often the most prominent symptom in scabies. Other local causes of urticaria are the stings and bites of insects and the stinging hairs of plants. *See* Sting: Stinging Plants and Animals.

Symptoms and Varieties.—Urticaria varies in the quantity and intensity of its several symptoms. Thus, it may be *general* or *partial*; or it may be distinguished by excess of hyperæmia, of itching, or of prominence and definition of its nodulated protuberances. Its most conspicuous character is the suddenness of its attack, and the equal suddenness of its dispersion, vanishing in a few hours or less without leaving a trace of its previous existence on the skin. But whilst it thus disappears completely on one part, it is apt to show itself on another, and in this manner to keep up the disease for a considerable time; returning, for example, nightly, and interfering with the sleep of the patient for weeks and even months. Moreover its characteristic tubercles, which are pale or white, and show out conspicuously on a bright red ground, may be isolated and dotted over the skin, or accumulated in clusters; they may be superficial, or they may be more or less deep-seated. These several diversities of symptoms have suggested a variety of descriptive appellations for the affection, for example: *U. evanida* or evanescent; *U. perstans* or persistent; *U. conferta*, congregated or confluent; *U. subcutanea* or deep-seated; and *U. tuberosa*, in tuberous masses; all of which varieties may be simply expressed by the terms 'more or less severe,' or 'more or less transient or chronic.

Urticaria has no constitutional symptoms of its own, but, being itself a symptom, may accidentally be associated with general derangement of the system, of greater or less severity. This fact is indicated by the term *U. febrilis*, which ought rather to be named *urticaria cum febre*; whilst another designation relating to its cause is met with in the term *U. ab ingestis*. Some of its features are found likewise in association with other forms of disorder of the skin; such as its tendency to swell in erythema papulosum, tuberosum, and tumescens; and its pruritic proclivity in lichen urticatus and prurigo.

Diagnosis.—The pathognomonic characters of urticaria are, first, white prominences of the skin, sometimes taking the form of round tubercles, at other times occurring in stripes or wheals of varying length and figure, which are shown up on a scarlet or bright crimson ground, and are accompanied by a sense of burning and prickling, suggestive of the painful sensation caused by the sting of a nettle; and, secondly, the sudden and complete evanescence of the local signs, as well as of the associated pruritus, without organic lesion of the skin.

Prognosis.—Urticaria may be very troublesome, but is rarely serious. As a symptom of some other form of derangement, the discovery of the latter must guide our opinion as to the cause and issue of the skin-affection.

Treatment.—The evanescent nature of the local affection points to the consideration of a constitutional treatment by which we may strengthen digestion, assist the functions of the liver, and maintain a healthy operation of the alimentary canal. A tonic-aperient medicine, combining sulphate of magnesia with quinine and a bitter infusion, will afford immediate relief where the digestive organs are concerned. Bilious and gouty subjects may be assisted by a preliminary blue-pill. The tone of the stomach may be kept up by nitro-hydrochloric acid combined with a bitter; in other instances, alkalies will be found serviceable. In neurotic constitutions, on the other hand, we must have recourse to quinine in

moderate doses, to the bromides, and occasionally to sedatives, to procure rest at night and induce sleep. In very chronic cases the liquor arsenicalis, in doses of three minims three times a day, is of decided advantage.

To relieve local suffering the best remedy is a lotion of lime-water inspissated with oxide of zinc, one part of the latter to eight of the former. In more severe cases the hot bath may be found serviceable; or heat applied by means of flannel or a sponge wrung out of hot water.

ERASMUS WILSON.

**UTERUS, Diseases of.** *See* WOMB, Diseases of.

**UVULA, Diseases of.**—SYNON.: Fr. *Maladies de la Luette*; Ger. *Krankheiten des Zäpfchens.*—Suspended from the middle of the lower and free border of the soft palate, is that small conical-shaped prolongation termed the uvula. In structure it is exactly the same as—indeed it is a portion of—the soft palate, which consists of a fold of mucous membrane, inclosing muscles, aponeuroses, vessels, nerves, and glands, the latter being very numerous.

From its intimate relation with the soft palate, the fauces, the tonsils, and the pharynx, the uvula is likely to become involved when any of these parts is overtaken by disease. This is most evident in cases of catarrhal angina. It is extremely rare for the uvula to be primarily and exclusively attacked with **inflammation**, and yet instances of such an affection are on record. On the other hand, it is by no means uncommon to observe the uvula swollen, œdematous, and elongated, as a consequence of prolonged irritation, **relaxation**, or often repeated catarrh of the fauces. That form of acute catarrh, of which the uvula partakes when the throat is the subject of this affection, disappears along with the other symptoms. But the condition known as **elongated uvula** often proves very intractable to treatment for a long time, and all the more so that not very infrequently this condition is entirely overlooked by the practitioner. It ought to be laid down as a rule, that, in all affections of the throat, the parts should be inspected. In this case, inspection will reveal that the uvula is greatly lengthened, but not of necessity always thickened or œdematous; so that when the patient reclines, this pendulous body falls backwards, sometimes even dropping so low as to reach the glottis. The consequence is, that the mucous membrane of the pharynx and larynx is kept in a continual state of irritation and general uneasiness. A peculiarly annoying cough is set up by the constant tickling of the parts, so that this condition of the uvula may even at times be recognised by the quickly repeated, resultless, brassy cough. It may be described as a quick, ineffectual hack. An inclination to vomit is also induced. An irresistible desire to swallow is observed, owing to the sensation which the patient perceives in the throat, as if something were lodging there, and which ought to be got rid of by swallowing. If there be much thickening as well as elongation of the uvula, then some slight difficulty may be experienced when deglutition takes place. When the elongation is very pronounced, and the uvula finds its way into the larynx, the patient may experience a sense of suffocation, particularly if he happen to be asleep, when he suddenly wakes up in a state of great alarm and breathlessness. A more temporary condition of elongated uvula is observed in that form of relaxed fauces which public speakers and singers are subject to, and which comes on suddenly, or quickly, after continuous use of the voice for an hour or more.

TREATMENT.—The condition associated with elongated uvula must be treated on general principles (*see* PHARYNX, Diseases of). Locally, the elongated uvula is best treated by astringent gargles. One of the best of these, which is perhaps as soothing as astringent, is the bromide of ammonium gargle, 20 grains to the ounce of water. Glycerine of tannin, tincture of iodine, and other agents which are quite sufficient for the cure of the simply relaxed uvula, may prove insufficient to restore the elongated uvula, and then a portion of it must be removed, even to the extent of two-thirds.

**Bifid Uvula** is a deformity usually congenital, the treatment of which, if necessary, by the actual or galvano-caustic cautery, or other means, falls within the domain of surgery.

**Paralysis of the Uvula** is met with as a sequela of diphtheria, when other parts of the throat are similarly affected. *See* PALATE, Diseases of; and PARALYSIS, Diphtheritic.

CLAUD MUIRHEAD.

# V

**VACCINATION** (*vacca*, a cow).[1]—SYNON.: Fr. *Vaccination*; Ger. *Kuhpockenimpfung.*

DEFINITION.—Inoculation with the material of vaccinia or the cow-pox. Its purpose, as applied to the human subject, in which relation alone we have here to consider it, is the protection of the person vaccinated from an attack, and especially from a severe or fatal attack, of small-pox.

The cow-pox, which is a natural, though not common, disease in the cow and horse, never occurs spontaneously in man. Nor is it communicable to him by effluvia, or in any other way than by the direct inoculation of its own specific virus. Such inoculation before the time of Jenner was never more than a matter of mere accident, and occurred with comparative rarity.

[1] This article, which was written by the late Dr. Seaton, has been revised by Dr. Collie. The passages inserted by the latter are marked [ ].

It was matter of popular tradition, but was left for Jenner to demonstrate, that persons who had thus been accidentally vaccinated enjoyed immunity subsequently from small-pox; and it was by his great discovery that the cow-pox, once implanted in the human subject, may be continued by inoculation from individual to individual indefinitely, that the practice of vaccination became possible.

Phenomena of Vaccination.—The phenomena which follow inoculation with the material of cow-pox vary according as the person, in whom the vaccine lymph is inserted, may or may not have been the subject of a previous successful vaccination [a previous inoculation, or a previous small-pox]. The description may be divided into (1) the course of **primary** vaccination; and (2) the course of **secondary** vaccination, or revaccination.

**1. Course of primary vaccination.**—This may be *regular*, *irregular*, or *complicated*.

(*a*) *Regular course.*—When lymph, taken from a vaccine vesicle at that period of its course when the vesicle is fit for the purpose, is inserted into the skin by puncture, or is applied to a small abraded surface of the skin of an unprotected person, no particular effect is noticeable till about the end of the second day, or early on the third day. By this time, if the vaccination be about to succeed, a slight papular elevation becomes perceptible. This, by the fifth or sixth day, has become a distinct vesicle of a bluish-white colour, with raised edge and central cup-like depression. By the eighth day (the day-week from that on which the lymph was inserted) it has attained its perfect growth; it is then plump, round, more decidedly pearl-coloured, and distended with clear lymph; its margin is firm, and central depression very marked. On this day, or sometimes even by the end of the seventh day, a ring of inflammation, called the areola, begins to form about its base; and the vesicle and areola together continue to spread for the next two days. The areola is circular, and when fully developed has a diameter of from one to three inches, being then often attended with considerable hardness and swelling of the subjacent connective tissue. After the tenth day the areola begins to fade; and in two or three days more it has usually disappeared, with whatever of hardness or swelling may have existed. With the decline of the areola the vesicle begins to dry in the centre; the lymph remaining in it becomes opaque and gradually concretes; and by the fourteenth or fifteenth day a hard brown scab is formed, which gradually contracts, dries, and blackens, and from the twentieth to the twenty-fifth day, but usually about the twenty-first day, falls off. There is then left a cicatrix, which is circular, somewhat depressed, foveated, sometimes radiated, and, with rare exceptions, permanent in after-life.

If the lymph have been inserted by two, three, or more punctures set near together about one spot, or by abrasion over a sufficient surface, two or more vesicles may arise at the spot; and in the course of their growth, either form a large vesicle of a compound character, with but one central depression, or a crop of vesicles, generally coalescing, but each retaining its own central depression. These compound vesicles and crops are round, oval, or of irregular outline, according to the manner in which the cutis has been penetrated or exposed; and the shape of the resulting cicatrices varies accordingly. Vaccination which has gone through the course above described is held to be protective against small-pox.

The constitutional symptoms attending these local phenomena are a rise of temperature, sometimes detectable by thermometer as early as the fourth day, more marked, but still often very slight from the fifth to the seventh day; more obvious feverishness, with restlessness, and frequently derangement of the stomach and bowels, from the eighth to the tenth day, that is, during the stage of areola, subsiding as that subsides. The general symptoms are in most cases quite moderate, and often exceedingly slight. Occasionally, when the areola is at its height, swelling of the axillary glands may be intense; and occasionally also at that period in young children of full habit, especially in hot weather, an eruption of roseola (*vaccine roseola*) may occur, chiefly on the extremities; or a papular eruption (*vaccine lichen*); or a vesicular one—the vesicles, however, [differing from] vaccine vesicles, in being entirely free from central depression. The duration of any of these forms of eruption, when they do occur, is very transitory, usually not extending beyond a week, and very seldom indeed beyond the falling of the scab.

(*b*) *Irregular course.*—The exactitude with which vaccination in the immense majority of cases runs the course above described is very remarkable; but in some cases an irregular course is seen. The irregularity may be merely in point of *time*; the development of the vesicle being retarded one or two or several days, or being slightly accelerated, so as to present, for example, by the eighth day, the appearances usually seen on the ninth. If the phenomena are in all other respects regular, these mere variations in time do not [as far as known] affect the protective power of the vaccination. On the other hand, there may be irregularity of the *character* and *course* of the vesicle, constituting *spurious vaccination*, on which no reliance can be placed for protecting from small-pox. Thus, papules or even vesicles may arise, which, instead of undergoing their proper development, begin by the fifth or sixth day to die away, leaving a mere scale or slight scab by the eighth day. More frequently, there are vesicles beginning early after the insertion of the lymph, with itching and irritation—symptoms almost invariably absent in a normal primary vaccination, assuming as they rise an acuminated or conoidal form, instead of the characteristic flat form with central depression; containing straw-coloured or opaque fluid, instead of clear lymph; and developing an early and irregularly-shaped areola, which is at its height by the fifth or sixth day, and far on the decline by the day-week. In other cases the vesicles, rising apparently more regularly at first, are found by the eighth day to have burst; and present either an irregular scabby appearance, or are in the state of open sores. The

chief causes of these irregularities will be discussed further on.

(*c*) *Complicated course.*—In spurious vaccinations, especially in the kind last described, and even in the course of a regular vaccination, if the vesicles have been rubbed or otherwise injured, ulcerated sores may succeed, requiring, in children who are of scrofulous or otherwise unhealthy constitution, some time to heal. Occasionally, also, in children of such habit of body, the swelling of the axillary glands, which has been mentioned as sometimes attendant on the areola, may result in abscess. But the only complication which can be regarded as at all formidable is erysipelas. This disease may of course supervene on vaccination, as it may on any other surgical operation, when the conditions which ordinarily give rise to it exist, and especially where there has been exposure to its contagium. [The lesson which this teaches us is not that we should not vaccinate, but that we should guard the place of operation against the entry of dirt or decomposing matter; alike at the time and during the course of vaccination. If erysipelas be from any cause set up during vaccination, it will occasionally be serious and even fatal, just as if it followed on another kind of wound.] But there have been cases, happily rare, in which it has manifestly arisen from the use of improper lymph, that is, from lymph taken from spurious vesicles, or from regular vesicles at an advanced period of their course, or which has been spoilt in keeping.

2. **Course of re-vaccination.**—In some persons the *regular* phenomena of vaccination can only be produced once in the lifetime. But this is not always the case, and vesicles may be produced by a second vaccination, not distinguishable in their appearance from primary vesicles, though usually having a smaller and more transitory areola, and having a small and poor cicatrix. Much the most frequently the result of that process is the production of a spurious papule or acuminated vesicle, with hard, irregular areola, reaching its height by the fifth or sixth day, and having by the eight day an imperfect scab, which soon falls. There is often much itching and more serious local irritation; and the constitutional symptoms are out of all proportion more frequent after re-vaccination than after primary vaccination. In some persons no specific local effect is producible by re-vaccination.

Performance of Vaccination.—(1) **Age.**—Small-pox being a disease to which persons are liable from the moment of birth, and which is peculiarly fatal in infancy, it is of great importance that vaccination should be performed in very early life. In large towns, where a weekly supply of lymph from arm to arm can always be maintained, the vaccination of children who are plump and healthy should be effected within four or six weeks from birth. If the child be less robust, it may properly be deferred for three or four weeks more. In small towns and rural districts the age at which vaccination can be performed must depend to some extent on the arrangements for lymph-supply in the district; but these are always such as admit of a child being vaccinated within a very few months from birth. It is under ordinary circumstances a preliminary condition of the performance of vaccination, that the child to be vaccinated should be healthy; and a careful examination to ascertain this is the first duty of the vaccinator. The child should not only be free from any acute febrile disease, but also from diarrhœa and from cutaneous diseases, especially those of the vesicular type. The states of constitution associated with herpes and eczema singularly interfere with the proper course of vaccination, and seem to be the most frequent causes of those spurious results of vaccination just described. They may both—especially intertrigo—without care, be overlooked; hence examination of the scalp, and of the folds of skin behind the ears, in the neck, and in the groins, is indispensable. Vaccination should also be postponed if erysipelas be prevailing in the neighbourhood in which the child is living, or if it have been recently exposed to the infection of measles or scarlatina. There is, however, a state of things under which these conditions must be disregarded, namely, when there may be *immediate* exposure to the infection of small-pox, as when an unvaccinated child is in a house in which the infection exists, or has come into direct contact with an infected person. Under such circumstances, it cannot be too strongly impressed that no age is too early for vaccination, and no state of health, except the presence of acute disease of a serious character, can be held to contraindicate it. Life then may depend on the promptitude with which the vaccination is done.

(2) **Selection of lymph.**—The second point to attend to is the selection of the lymph to be used in vaccinating. [This may be of two kinds, bovine or human. The advantages claimed for the former are immunity from human disease and greater protection from small-pox. As the risk of conveying human disease is infinitesimal, if the vaccination be done with due care, much weight need not be attached to this; and, moreover, if the argument be sound, it applies *à priori* to the bovine lymph as well as to the human, so that by the adoption of bovine matter we merely substitute one possible risk for another. It is true that the bovine lymph is recommended on the ground that no disease other than cow-pox is capable of being communicated to man by inoculation with it; but this statement must for the present be open to question. In the selection of lymph, whether bovine or human, the important point is to select healthy subjects; and it is probably as easy to select a healthy infant as a healthy calf. Of the greater protection from small-pox, this is not yet established on a sufficiently wide induction, and years must yet elapse before it can be. If the bovine lymph be preferred for general use, it will still be well to choose humanised lymph in the case of delicate children, because of the severity of the local effects when bovine lymph is used. The present writer in the existing state of knowledge prefers humanised lymph, which, as employed by his colleagues and himself, he has never found ineffectual; but, whilst of this opinion, he thinks the propriety of more frequent recourse to the calf, for the purpose of renewing our stock,

deserves consideration.] Human lymph should be taken from primary cases only, from perfectly healthy subjects, and from thoroughly characteristic vesicles. Babies selected for the purpose should not only be in good health themselves, but, as far as can be ascertained, of healthy parentage. Those of dark complexion, not too florid, with a thick smooth, clear skin, generally yield the best and most effective lymph. Vesicles from which the lymph may be taken must be well characterised, uninjured, and free from areola. Lymph may, with perfect propriety, be taken so soon as any can be obtained from a vesicle, as at the fifth or sixth day of its course; but it is then procurable in very small quantity, and it is usually and most conveniently taken on the day-week from the vaccination, when the vesicle is perfectly formed, but before the stage of areola has set in. Any vesicle, which at that date manifests areola, must be discarded. This was Jenner's 'golden rule,' and one which ought to be scrupulously observed. Good vaccine lymph is always perfectly limpid, and has besides a certain degree of viscidity. A thin, serous, too-readily flowing lymph should never be used.

(3) **Method of collecting lymph: Arm-to-arm vaccination.**—The collection of lymph from the human subject for vaccinating is effected by opening the vesicle by numerous minute punctures on its surface, the utmost care being used not to draw blood. Should any accidentally be drawn, the vesicle must be discarded altogether. No lymph must be used which does not exude spontaneously; there must be no pressure or squeezing of the vesicle. The lymph which stands on the surface of the opened vesicle, is taken on the point of a lancet or other instrument employed, and inserted in the arm of the child to be vaccinated. This may be done in various ways, as by puncture, by scratching, by scarifications or abrasions, by tatooing, &c. It would not be possible, within the limits of this article, to give any description of these various modes of operating. Nor would it be of much use. They should be learnt practically under a good instructor. All of these methods may, in careful and skilled hands, be made equally successful. That, however, which in the hands of practitioners generally the writer has found the most successful, has been the plan by scarification or tattooing ∴∴, over surfaces of the extent here depicted. Insertions to this extent should be made on at least four, and preferably five, separate surfaces. If the vaccination be done on both arms, the writer recommends three insertions of this kind in each arm; if it be done on one arm only, then there should be five on that arm. [While an ample primary vaccination affords better protection against small-pox than a scanty primary vaccination (*see* p. 1723), it has to be admitted that no number and no quality of marks give absolute protection for all time, nor even, in all cases, for many years. In well-vaccinated children under ten, for instance, re-vaccination produces large vesicles with well-marked areolæ. Some of such children are certainly liable to contract small-pox, the certainty being proved by the fact that they have contracted it. For this reason and seeing that susceptibility to re-vaccination may (for all that is known to the contrary) be an indication of susceptibility to small-pox, there is something to be said for a repetition of the operation, in well-vaccinated persons, whether children or adults, when small-pox is epidemic. It is certain that the best vaccination will not always protect up to that very vague period called puberty, a period reached at different ages by different persons. Under what circumstances, and how often, vaccination should be repeated is a subject for enquiry; but the experience of small-pox in London during the last ten years proves that in some cases re-vaccination cannot be delayed until puberty, and that a single re-vaccination, when then successfully performed, is not an absolute protection for all time against attack, or even death from small-pox.] In vaccination by other modes of procedure, care should be taken that local results to the full extent are obtained. An ordinary ungrooved lancet is, in the writer's opinion, the best of all instruments for the performance of vaccination. It is not only readily cleaned, but it is one concerning which we can always be sure that it *is* clean. Lancets used for vaccination should be kept bright, and should never be used for any other purpose. If used for more than one vaccination at a time, they should be most carefully cleansed after each case.

(4) **Storage of lymph: indirect vaccination.**—Vaccination should in all cases in which it is practicable, be done direct from arm to arm. The degree of success attending the use of conveyed or stored lymph, in whatever way the conveyance or storage be effected, does not approach that of lymph thus directly transferred. Where vaccination from the arm is impracticable, lymph intended for immediate use may be conveyed from case to case, in the liquid form, by means of the vaccine bottle and other contrivances for the purpose; but it must be a quite indispensable condition of this proceeding that the lymph be used within a few hours—six to eight at the outside—of its being taken. For longer keeping it must be stored either in hermetically-sealed tubes, or on points thickly coated with it, then carefully dried, and kept afterwards constantly protected from damp and heat. When stored in the latter way, the lymph needs revival before use by dipping the point for an instant in water, and laying it on the edge of a book, so that the lymph may become soft. In the use of stored lymph the process of vaccination by scarification or abrasion is always to be preferred.

(5) **After-treatment.**—When the vaccination has been done, the parent should be cautioned against allowing the vesicle to get rubbed or mechanically injured. The case should be seen again by the day-week at least, when, if the vesicle be perfectly formed, and pursuing a regular course, the success of the vaccination may fairly be pronounced. But if the case be then retarded, it should be seen again two or three days afterwards; or if there be anything abnormal in the appearance of the vesicle, the case should be watched unfailingly throughout its course.

VACCINATION AS A PROTECTION AGAINST SMALL-

POX.—The protection which vaccination affords against small-pox is manifested in two ways: first, by the immunity from that disease which, as a rule, it confers; secondly, by the modification which, when immunity is not complete, it induces in the course and severity of the disease in the majority of cases. The most precise of the numerous facts which exist in proof of this are those derived from the Small-pox Hospital in London, where it has been found that while small-pox in the unvaccinated patients runs an unmodified course in all but 2·6 per cent., its course in vaccinated patients is modified in 73 per cent.; and that while the death-rate of natural small-pox is 35·55 per cent., that of post-vaccinal small-pox is but 6·56 per cent. [This latter figure, obtained from cases admitted into the Highgate Small-pox Hospital in the years 1836–55 is lower than would be given from the experience of the Asylums Board Small-pox Hospitals, during later years. The difference is due, in part, to the circumstance that Mr. Marson excluded what he called 'antecedent or superadded disease'; in part probably to the greater fatality of small-pox during more recent years, a circumstance which has also shown itself among the unvaccinated; and in part perhaps to the cases admitted to the latter hospitals belonging to a more destitute class of the community. In the Asylum Board Small-pox Hospitals, where all deaths are included, the post-vaccinal mortality has amounted to 8 per cent.] The difference between 35 and 6, however, gives but a feeble idea of the protection which vaccination really affords, provided it be thoroughly done; for in nearly all the fatal cases the vaccination was found to have been of an imperfect character, and had not been done in accordance with the rules laid down above. The following table published some years ago, based on an examination of 5,000 cases, gives the results of Mr. Marson's observations, extending over twenty years:—

| Classification of Patients affected with Small-pox | Number of deaths per cent. in each class respectively |
|---|---|
| 1. Unvaccinated | 35 |
| 2. Stated to have been vaccinated but having no cicatrix | 23·57 |
| 3. Vaccinated:— | |
| *a.* Having one vaccine cicatrix | 7·73 |
| *b.* Having two vaccine cicatrices | 4·70 |
| *c.* Having three vaccine cicatrices | 1·95 |
| *d.* Having four or more vaccine cicatrices | 0·55 |
| *α.* Having well-marked cicatrices | 2·52 |
| *β.* Having badly-marked cicatrices | 8·82 |
| 4. Having previously had small-pox | 19 |

[These facts are confirmed by the experience of the Small-pox Hospitals of the Asylums Board, as the following table, prepared by Dr. MacCombie of the Deptford Small-pox Hospital, will show:

Statistics of 11,724 cases of Small-pox treated in the Hospitals of the Metropolitan Asylums Board during the years 1871–78:—

| | | Cases | Deaths | Mort. p.c. | Marson's mort. p.c. corrected to include antecedent and superadded disease |
|---|---|---|---|---|---|
| One Mark | Good | 1095 | 70 | 6·4 | 5·2 |
| | Indifferent | 2004 | 341 | 16·7 | 13·8 |
| Two Marks | Good | 1461 | 54 | 3·7 | 3·6 |
| | Indifferent | 2476 | 279 | 11·2 | 9·9 |
| Three Marks | Good | 1095 | 41 | 3·7 | 2·2 |
| | Indifferent | 1778 | 133 | 7·4 | 4·1 |
| Four Marks | Good | 826 | 23 | 2·7 | 0·55 |
| | Indifferent | 949 | 46 | 4·8 | 1·6 |
| Total . . . | | 11724 | 987 | 8·1 | 6·6 1836–55 |

Good marks:—4477 cases, 188 deaths. Mort. p.c. 4·1. Indifferent marks, 7247 cases, 799 deaths. Mort. p.c. 11·0

[It deserves to be noted that, if Mr. Marson's experience in 1836–55 were expressed in the same terms as the foregoing we should obtain: Good marks, 2570 cases, 95 deaths. Mort. p.c. 3·6. Indifferent marks, 1956 cases, 206 deaths. Mort. p.c. 10·5.]

The apparent selection of years between 1871 and 1879 is due partly to the fact that the hospitals were not continuously open for small-pox, and partly to the fact that the statistics were not all compiled on the same plan during the period.]

To produce then at least four perfect vesicles, leaving four characteristic cicatrices, should be the aim of every vaccinator.

RE-VACCINATION.—The necessity for re-vaccination—a term the use of which should always be restricted to cases in which vaccination had already been performed *with effect*—has always been recognised in certain cases; but it is only of late years that its importance *as a practice*, after a certain period of life, has begun to be understood. (1) The cases in which later vaccination is most obviously required are those in which the effect of the first 'vaccination' has been of the irregular or spurious kind already described, from which no protection against small-pox can be assured. Circumstances must determine in the case of any particular child how soon a completer vaccination should be performed; but especial care should be taken, before proceeding to vaccinate again, to scrutinise the health of the child, and to correct anything in it which may be found amiss. The re-vaccination should be done with every precaution against failure, and therefore, always, if possible in cases of this kind, direct from the arm. If it totally fail, it will need, of course, to be repeated at intervals till some result is obtained. This result may be a complete success, but more frequently it will be only a modified success, with which, however, the practitioner will have to be content for the present. He will not fail, however, to impress the necessity for a further re-vaccination at puberty, or earlier if there be any immediate danger of small-pox. (2) When primary vaccination has been successful to a certain extent, but not to the extent desired, for example, when there have been one or two vesicles only instead of four or more, but these vesicles quite genuine,

re-vaccination at puberty is of great importance, but need not, except under circumstances of immediate exposure to small-pox, be recommended earlier. [Considering that the best primary vaccination does not confer complete protection up to the varying time of puberty, I should be disposed, for my own part, to advise re-vaccination before that period even in the case of persons well vaccinated; and probably the age of ten years would be the most generally suitable. A. C.]. (3) Following the foregoing rules, a practitioner, who has to decide the question of re-vaccination in cases in which he did not himself perform or see the original vaccination, and who must therefore determine by the marks, would recommend re-vaccination as soon as practicable in cases in which the cicatrices wanted the true vaccine character, but would advise waiting when they were genuine in character and wanting only in number. (4) The systematic performance of re-vaccination at puberty is a practice, the importance of which must now be regarded as demonstrated. It is of course infinitely more important to those whose vaccination has been incomplete, than to those whose vaccination has been thorough, but even the best vaccinated derive additional security from it. [When small-pox is of epidemic intensity, even the best vaccinated adults incur appreciable danger of attack; but with them the disease, if it do occur, is in the majority of cases mild and rarely fatal. Amongst re-vaccinated adults attack is rarer still and death is almost unknown.] The reason why the period of puberty, or thereabouts, is fixed on as the time for the systematic performance of re-vaccination, is simply that it is only after that period that serious attacks of post-vaccinal small-pox are, as a rule, met with. The post-vaccinal small-pox, which may occur in childhood, is [as a rule, to which there are exceptions], unless when the vaccination has been very imperfect, of little danger.

Alleged Dangers of Vaccination.—The tendency of parents to refer to vaccination every disease, especially every cutaneous disease, which the child may afterwards manifest, is well known. Most of such allegations are without proof or probability—mere illustrations of *post hoc propter hoc*. It is quite possible, indeed, that in some cases vaccination may, like teething or other irritative cause, hasten the evolution of a constitutional eruption which the child was incubating; but even this is not a common occurrence, nor is it at all within the meaning of the allegation. The only real danger which need be considered here (the danger of erysipelas having been already indicated) is that of the introduction of syphilitic infection along with the vaccine. It is by means of the blood that syphilis has been introduced. Such an accident, though rare, is of the most serious consequence when it does occur, not only on account of the injury inflicted on individuals, but from the damage done by it to the reputation of vaccination; and every practitioner is bound to the most scrupulous observance of the precautions whereby these evils may be avoided. The precautions are (*a*) extreme care in the choice of vaccinifer; (*b*) brightness and cleanliness of lancet, with careful cleansing after each separate vaccination; (*c*) scrupulous care in opening the vesicles of the vaccinifer not to draw any blood, and not to use the lymph of any vesicle from which blood may accidentally have been drawn; and (*d*) care also not to take from lymph-vesicles in which there is an areola, and in which therefore the normal contents of the vesicle will have become mingled with the products of common inflammation. E. C. Seaton.

**VAGINA, Diseases of.**—Synon.: Fr. *Maladies du Vagin*; Ger. *Krankheiten der Scheide.*

The vagina frequently participates in the morbid processes which affect the uterus and other neighbouring organs. The vaginal affection is then a matter of minor importance, and may not call for special recognition. But this organ is often enough the seat of independent diseases, the more important of which will now be considered.

1. **Atresia.**–Imperforate vagina is met with as a congenital or acquired malformation. *Congenital atresia* may occur alone: or it may be complicated with absence, imperfect development, or closure of the orifice of the uterus. Occasionally the vagina is bifid, and the atresia affects only one side, in which the menstrual fluid of the corresponding horn of the uterus may accumulate, producing the condition described as *hæmatokolpos lateralis*. The occlusion may first affect the organ in its entire length; or, secondly, for a half or third of its length, most frequently towards the lower extremity; or, thirdly, it may be simply membranous, as from a too complete hymen. The congenital atresia is usually complete, so that the passage to and from the uterus is perfectly occluded. *Acquired* or *accidental atresia*, on the other hand, may present any degree of constriction, from a slight and partial narrowing of the canal up to its total obliteration. We find it resulting, first, from sloughing after labour, when it is frequently complicated with vesical or rectal fistulæ; secondly, from sloughing after fever; thirdly, from chronic inflammations and ulcerations; fourthly, from applications of caustics.

Symptoms and Diagnosis.—There are three stages at which atresia may betray itself by symptoms. First, after puberty has set in, the patient has the usual indications that ovulation is taking place, but she suffers from *amenorrhœa*. The uterine hæmorrhage is taking place; but the extravasated blood is detained above the seat of occlusion, and does not appear externally. Secondly, in some women *dyspareunia* (impossibility of copulation) after marriage leads to the examination which discovers the obstruction. Thirdly, in the acquired variety the difficulty is often only discovered in consequence of the *dystocia* that results from the resistance offered to the advance of the fœtal head by the constriction of the canal. The physical examination may discover, first, on abdominal palpation, a swelling in the hypogastric or inguinal region, due to the accumulation of menstrual fluid in the upper parts of the sexual canals. Secondly, on vaginal exploration being attempted, either the finger is soon arrested within the labia, or a bulging fluctuating pouch is felt. Thirdly, we then examine *per rectum* or *per vesicam* with sound or finger, or through these cavities simultaneously, combining the explora-

tion by means of the fingers of one hand through the available openings in the pelvic floor, with pressure and palpation with the other hand above the pelvic brim. The exact seat and extent of the occlusion can thus be detected, and at the same time an estimate can be formed of the amount of accumulation that may have taken place above it.

PROGNOSIS.—(1) Where the obstructing membrane is thin, it may give way at a menstrual period, or under a gangrenous process. (2) The sac formed by the dilated uterine or Fallopian cavities may burst, and pour its contents into the peritoneal cavity. (3) In a considerable proportion of cases early menopause comes on, and lessens the risk. (4) Patients who suffer from atresia vaginæ, even when they have been relieved by operative measures, show a tendency to die of consumption.

TREATMENT.—In view of the dangers associated with the accumulation of menstrual fluid in the genital canals, the indication usually becomes very clear for their evacuation by perforating the obstructing tissues. But this operation has often been followed by disastrous results. Not to speak of the risks of wounding the bladder or rectum, or of setting up pelvic cellulitis, in cases where there is total absence of the vagina, and a canal needs to be tunnelled to the uterus, emptying of a hæmatometra and hæmatokolpos has been followed by death, sometimes from septicæmia, sometimes from bursting of the sac above when pressure is made on it; or dangerous inflammation has been set up in the pelvic organs. Care must be taken never to empty the sac by pressure from above, but by washing it out with a warm antiseptic fluid through an opening, which may be made under antiseptic precautions. Where the atresia has been extensive, there is a strong tendency to its repeated closure. This must be averted by making the patient wear a glass or vulcanite tube, filled with cotton wadding soaked in carbolised oil, through which the uterine cavity can be occasionally washed out until it has collapsed. This must be worn for some months, until the vaginal canal has fully cicatrized around it.

2. **Displacements.**—When the perinæum has become relaxed or lacerated, hernia of the pelvic contents is apt to occur to a greater or less extent. The descent of the uterus in such cases has commonly been regarded as their most important feature, and they have generally been described as *prolapsus uteri*. When the protrusion or herniation, however, is complete, the walls of the hernial sac are formed chiefly by the walls of the vagina, and we get the most extensive displacement, or *inversion*, of the vagina. The symptoms and treatment of this inversion belong to the history of uterine displacements. But we may have displacement of one or other of the vaginal walls as an independent mischief, or as the most prominent disturbance, in a case where the retentive power of the pelvic floor is impaired. If the anterior wall of the vagina descend, it carries with it the back wall of the bladder—*cystocele*. If the posterior vaginal wall descend, it brings with it the anterior wall of the rectum—*rectocele*.

The treatment of these conditions is either palliative or radical. The palliative treatment is effected by the use of astringent injections, and the application of vaginal pessaries—such as the Hodge pessary with cross bars towards its lower end. The radical treatment implies a plastic operation for repair of the relaxed or ruptured perinæum, or for producing a contraction in the displaced vaginal wall.

3. **Foreign Bodies.**—The vaginal canal is sometimes found occupied by foreign bodies. Every gynæcologist has met with cases where pessaries have been left in for years, until by their presence and pressure they began to set up ulcerative processes in the vaginal walls. Introduced at first with a useful object, and producing for a time a beneficial effect, their presence has sometimes been forgotten, until the discharges they excited has recalled attention to them. But bodies of quite another kind are sometimes met with, usually introduced by patients with onanistic propensities. Corks, pieces of wood, pomade-pots, fir-tops, dram-glasses, etc., have been met with in such cases. Portions of glass specula and of glass syringes have sometimes broken off in the hands of practitioners or patients. Ascarides and other parasites seem occasionally to make their way from the anus into the vagina.

Some of these foreign bodies are very easy of removal. Others are a source of great difficulty —those more especially which have become imbedded to some extent in the vaginal walls. Thus it may become necessary to anæsthetize the patient, to lay hold of the foreign body with a polypus forceps or vulsellum, and to detach it with the fingers or with a knife from the tissues that have granulated round it, before it can be withdrawn.

4. **Inflammation.**—SYNON.: *Colpitis; Vaginitis.*—Apart from gonorrhœal inflammation of the vagina we may have colpitis of a non-specific character, either as a primary disease, originating in itself, or spreading to it from the neighbouring structures. The causes of inflammation commencing in the vagina are found in chills (puerperal or menstrual); injuries (as from rude use of obstetric and gynæcological instruments); prolonged presence of pessaries; excessive coition; irritants (as in cases where nitrate of silver applied to the cervix has acted on the vaginal mucosa); neoplasms; and some of the fevers. In elderly women we meet with a *colpitis senilis* or *vetularum* (Ruge), the cause of which is not easily traceable, in which the mucous membrane, especially of the upper part of the vaginal tube, sheds its epithelial covering in patches, becomes studded here and there with papillary granulations, and shows a tendency to cicatricial contractions. In other women the colpitis in its acute forms is found as a catarrh of the mucosa, attended with swelling, rapid desquamation of epithelial cells, and exudation of a serous fluid, which mixed with the granular cells produces a milky discharge. In the chronic forms the discharge becomes more creamy or purulent, as the exudation is less copious, and there is more exfoliation of degenerated and often unripe epithelial cells; and then the surface is often thickly strewn with red papillæ, over which the epithelium is almost destroyed. The symptoms are local discomfort, and leucorrhæal discharges of various kinds; and the diagnosis is made by examination

of the discharge, and exposure of the affected surface by means of the speculum.

The treatment in the acute stage is directed to keeping the part at rest, and using sedative injections. In the chronic forms the use of the injection or douche must be steadily persevered in. The canal must be washed out with a stream of hot water, in the last pint of which alum or some other astringent has been dissolved. Where an acute process is likely to become chronic, or in the chronic forms attended with granulations on the surface, it is well to apply with a mop or brush a solution of nitrate of silver containing half a drachm to the ounce. Frequently the use of pessaries of oxide of zinc, bismuth, or iodide of lead, proves useful in cases where patients have difficulty in using the syringe or douche. In the *colpitis senilis* the distress which the patient feels from the irritating discharge is best relieved, and the unhealthy surface is most speedily brought to heal, by the application of bismuth powder, through a speculum or other tube, to the mucous membrane, after washing or wiping away the secretion.

5. **Injuries.**—It is principally in connexion with labour that the vaginal walls are liable to be injured. Not only in operative cases where the walls may get bruised and torn, or in tedious cases where the walls are so long compressed that they may afterwards slough and become the seat of fistulæ, but even in ordinary cases the vaginal mucous membrane is almost always fissured, or torn more or less deeply, at its lower extremity. These lacerations are mainly important because of their liability to become the channels through which septic matters are absorbed in the puerperal patient. In every case where there is a chance of infection, the canal should be syringed with a solution of carbolic acid; and it is a further safe precaution to keep the raw surface dusted with a powder of several grains of starch combined with one grain of salicylic acid, or with iodoform.

6. **Neoplasms.**—*Fibromata* affect most frequently the anterior wall of the vagina. They may be either sessile or pedunculated. They do not give rise to much distress, except from their pressure on the bladder, or from their protruding through the vulva. Extirpation affords the only cure, and in carrying out the operation care has to be taken to avoid injuring the bladder or urethra when they are seated anteriorly, and the rectum when they spring from the posterior wall. *Sarcomata*, round-celled or spindle-celled, have been in some few cases found springing from the vaginal walls. They have sometimes been described as growing from the submucous tissue. In the only case which the writer has met with, the growths arose from the mucous membrane. Early extirpation is indicated. These growths tend to recur. *Carcinoma*, more markedly even than the other neoplasms, is oftener a secondary than a primary affection in the vaginal walls. It may, however, originate in the vagina itself, running a course at least as rapid as in the uterus, and usually leading early to infiltration of the inguinal glands. It only admits of palliative treatment. *Cystomata*, like the simple solid tumours, are most frequent on the anterior wall. The contents are usually pale, and where they have attained the size of a walnut, watery. In the smaller cysts the contents are more viscid. Some seem to result from cavities into which blood has been extravasated, and then the contents are brownish. They must be freely evacuated, and iodine or nitrate of silver applied to their lining membrane; otherwise they are apt to be re-filled.



7. **Vaginismus.**—Under this designation has been described an affection of the vaginal orifice, which is not infrequent among recently married women, and which utterly unfits the subjects of it for enduring coition. In some of them the hymen is unruptured, and there are excoriations at its base, towards the navicular fossa. More frequently the hymen has been infringed, but the lacerations resulting from the immissio penis have not healed, or fissures have formed at the roots of the hymeneal flaps, and a chronic inflammation is set up in the tissues, which renders them exquisitely sensitive. In such a condition any touch, even of the finger, causes intense pain, and when an attempt is made to pass through the orifice, the constrictor vagina and the lower fibres of the levator ani are thrown into a tenesmic state, which prolongs the suffering. The leading symptom is the distressing dyspareunia; and the diagnosis is made by the touch of the finger, supplemented by inspection. An examination can often be effected only when the patient is placed under anæsthetics.

Treatment.—Treatment of a palliative kind may be attempted, making the patient use sitz-baths and apply emollients and sedatives. But it is far more satisfactory to have recourse to radical measures. The patient being under the influence of chloroform, the fragments of the hymen should be pared or clipped off. An incision should be made on each side of the vaginal opening towards its posterior aspect, running in a direction outwards and backwards, and passing through the whole thickness of the mucous membrane, and some portion of the thickness of the constrictor muscle. The points of four fingers of the hand gathered together and well greased, should then be passed through the dilated opening, so as fully to distend it, and produce complete relaxation of the sphincter. With due care the bleeding is trifling; the wound heals kindly; and undue contraction is prevented by making the patient wear, for half an hour or longer twice a day, a thick vaginal bougie. For a time the introduction of the bougie is resented, but the pain passes off when it is kept in position; and after a few days its passage ceases to be painful. This operation can be carried out with a very confident expectation that the dyspareunia will disappear; and if no other complication be present, the probability is that conception will ensue. Alexander Russell Simpson.

**VALENCIA, on the east coast of Spain.** A dry, variable, mild, winter climate. Mean winter temperature, 49·7° Fah. Prevailing winds E. (moist), W. and S.W. (rough). *See* Climate, Treatment of Disease by.

**VALS, in France.**—Alkaline waters. *See* Mineral Waters.

**VALVES, Diseases of.** *See* Heart, Valves of, Diseases of; and Pylorus, Diseases of.

**VARICELLA** (dim. of *Variola*).—A synonym for chicken-pox. *See* CHICKEN-POX.

**VARICOCELE** (*varix*, a dilated vein, and κήλη, a tumour).—SYNON.: Fr. *Varicocèle*; Ger. *Krampfaderbruch.*

DEFINITION.—A dilated, elongated, and tortuous condition of the veins of the spermatic cord, due either to increased pressure within the vessels, or to diminished resistance in the walls of the vessels and the surrounding structures.

PATHOLOGY.—The testicle, probably like other glands, receives supplies of blood varying with its activity; and the veins are numerous and tortuous, freely anastomose, are liable to intermittent compression in their passage through the inguinal canal from muscular contraction, and terminate on each side in a single vein, which, like the companion artery, is remarkable for its great length and small size. These conditions are favourable to the production of dilatation and varicosity. Diminished resistance in the walls of the vessels and surrounding structures, is, however, probably the chief cause. Varicocele is so much more frequent in the left than in the right spermatic cord, and when present in both is so much larger in the left, that the inferior muscular development of the left side of the body from predominant use of the right is very possibly a predisposing cause. The termination of the left spermatic vein at right angles in the renal vein, as compared with the termination of the right vein at an acute angle in the inferior vena cava, and the relation of the left vein to the sigmoid flexure, have been suggested as possible exciting causes; but their influence, if any, must be slight.

SYMPTOMS.—Varicocele is generally painless, but is sometimes associated with neuralgia or hyperæsthesia of the testicle. The subjects of it sometimes complain of a feeling of weight or uneasiness in the part, after standing or prolonged exercise; and in extreme cases, when the scrotum is very much relaxed, labouring men have found it a mechanical hindrance in their work. The testicle is usually normal, but is sometimes soft and even atrophied, but these conditions of the testicle are probably the result of other causes, and not of the varicocele. In such cases the patient is generally very hypochondriacal.

DIAGNOSIS.—The diagnosis is easy. The veins can be readily felt, and have been aptly compared to a bag filled with worms.

TREATMENT.—In slight cases of varicocele no treatment is required. The use of a light truss, with pressure sufficient to take off the weight of the superincumbent column of blood from the spermatic veins, without interfering with the current of blood through the spermatic artery, has been recommended with advantage. A well-fitting suspensory bandage, cold bathing, avoidance of constipation, and tonics, will suffice for most cases; and if operative interference be requisite, the writer has found excision of the veins, with antiseptic precautions, most satisfactory. Subcutaneous ligature and division of the veins have been recommended; but the result is always uncertain, and sometimes unsuccessful.

J. MCCARTHY.

**VARICOSE VEINS.** *See* VEINS, Diseases of; and VARICOCELE.

**VARIETIES OF DISEASE.** *See* DISEASE, Types and Varieties of.

**VARIOLA** (*varius*, spotted).—A synonym for small-pox. *See* SMALL-POX.

**VARIOLOID** (*variola*, small-pox, and εἶδος, form).—This term has been applied to a disease which has the characters of variola in a mild form, but which is really small-pox modified by previous vaccination or inoculation. *See* SMALL-POX.

**VEGETABLE PARASITES.** *See* PARASITES.

**VEGETABLE POISONS.** *See* POISONOUS FOOD; and POISONS.

**VEGETATIONS** (*vegeo*, I grow).—In modern pathology this term is usually applied to growths and deposits connected with the valves of the heart (*see* HEART, Inflammation of). The name is also given to excessive granulations on wounds, and to warty growths.

**VEINS, Diseases of.**—SYNON.: Fr. *Maladies des Veines*; Ger. *Krankheiten der Adern.*

The diseases of veins will be described in the following order:—1. Inflammation; 2. Varix; 3. Hypertrophy; 4. Atrophy; 5. Degenerations; 6. Phleboliths; 7. Wounds; 8. Parasites; and 9. New Growths. Neither thrombosis nor pyæmia, except in so far as they affect the vessel-walls, will be discussed here. Until late years, the term phlebitis included these diseases and many others, but they have been gradually separated now (*see* PYÆMIA; and THROMBOSIS). The subject of the entrance of air into veins is also separately considered. *See* VEINS, Entrance of Air into.

**1. Inflammation.** — SYNON.: Phlebitis; Fr. *Phlébite*; Ger. *Venenentzündung.*

DEFINITION.—Inflammation of the coats of a vein, associated with changes in the blood passing through the inflamed spot.

VARIETIES.—Numerous varieties of phlebitis exist, but no satisfactory classification of them has yet been made. Indeed, three methods of classification are suggested, namely, 1, according to the *intensity* of the inflammation—acute, subacute, or chronic; 2, according to the *condition of the thrombus* formed—whether adhesive or suppurative; and 3, according as the inflammation affects the different *parts of the walls*—endo-, meso-, exo-, and peri-phlebitis. The latter commends itself as the best, as it is chiefly with the walls of the vessels we have to do. Practically however, we may discuss the subject under two heads, namely *endophlebitis* and *periphlebitis.*

ÆTIOLOGY.—The chief cause of *endophlebitis* is the formation of a thrombus, and whatever leads to the one will cause the other. It is especially common in the last stages of exhausting diseases, such as phthisis, and as a complication or sequela of the acute specific fevers. *See* THROMBOSIS.

*Periphlebitis*, being allied to phlegmonous erysipelas, is set up by like causes. When open wounds exist, whether old-standing ulcers, recent wounds, amputation flaps, or direct wounds of veins, and when they are associated with bad

hygiene, there is a tendency to this form of inflammation. Overcrowding is a fruitful source of this and allied diseases; and the same must be said of chronic visceral trouble, such as kidney-disease.

Anatomical Characters and Pathology.—The pathology of phlebitis taken in the limited sense referred to, as it affects the vessel-walls, is best discussed according as the influences which alter the normal condition arise (*a*) in the blood, or (*b*) external to the vessel-wall.

(*a*) The inner wall of a vein consists of an endothelial layer, supported on a subendothelial basis of connective tissue. It is extravascular, but under certain circumstances is liable to inflammatory and other changes.

From *within* the vessel the only possible irritation must come from the blood. That fluid blood, however loaded it may be with poisonous matter, can cause an appreciable change in the coats of the vein, is not known or believed. Blood, however, when coagulated, does cause changes in the vessel-wall, and the presence of this deposited fibrin, coagulated blood, adhesive clot, or thrombus, by whichever name we prefer to call it, is the starting-point of whatever endothelial change is derived from within. When a thrombus forms, contraction of the vessel-wall and staining of the intima occur; the staining is exactly commensurate with the extent of the thrombus, and is of a uniform reddish hue. The irritation set up by the thrombus will cause a determination of blood in the vasa vasorum, and the sheath and the outer and middle coats of the vein become injected and thickened. The endothelia now swell, the sub-endothelial cells become more numerous, active, and finally find their way into the thrombus. There will in this way result an adhesion between the vessel-wall and the thrombus, especially at its lower end, where it occupies the whole calibre of the vessel.

From the contraction of the thrombus and the paralysis of the muscular fibres of the middle coat, the vein will be thrown into longitudinal folds; these effects, however, are purely mechanical, as by injecting the vein with water the folds readily disappear. The idea that a fluid lymph was effused on the inner surface of the vein was long believed. Experiments appeared to show that after irritation lymph was effused on the inner surface of the vein. The details of the experiments, however, were proved to have been inaccurately performed, as lymph was allowed to travel through the openings made in the veins, for the purpose of inducing the irritation. When this was prevented by tying firmly the mouth of the opening through which the irritating substance (say a needle) was introduced, not only no lymph was found, but the blood remained fluid, and no change took place in the vessel-wall. The end of the relationship between the thrombus and the vessel may then be one or the other of the following:—liquefaction of the thrombus and return to the normal state of the vessel; adhesion between thrombus and vessel-wall, growing more and more intimate, the vessels of the outer coat and the thrombus becoming continuous; the whole of the vein and contents may become a streak of fibrous tissue; or they may undergo calcareous infiltration.

(*b*) The sheath and the outer coat are the parts of the vein first liable to inflammatory or other changes commencing from *without*. Around superficial veins especially, the tissue is loose and areolar, and in it the lymphatics travel upwards to the glands. Pus finding its way into this loose tissue is readily conducted upwards or downwards. The old name for peri-phlebitis was 'suppurative' or 'diffuse' phlebitis; it is a disease allied to phlegmonous erysipelas, the pus in phlebitis travelling along the loose connective tissue surrounding the veins, instead of being diffused in the general connective tissue, as in phlegmonous erysipelas. The origin of the inflammation may be in an open wound, an ulcer, an extravasation of blood, an abscess, especially ischio-rectal; in a viscus such as the bladder or prostate; in the separation of the placenta; or as a consequence of osteomyelitis. No change need necessarily occur at the wound; the surface may remain healthy, whilst the inflammation extends along the sheath of a vein leading from it. It may be some distance above the wound that the effect of the inflammation shows itself; if on the leg the pus may develop in the region of the popliteal space, if in the forearm at the elbow or axilla. The spot is apparently largely determined by the looseness of the tissue. The inflammation set up ends in the formation of pus, which may accumulate in sufficient quantity to form a large abscess. Several effects will follow these changes on the sheath. First, the nutrition of the coats of the vein will be interfered with, through the blocking up of the vasa vasorum. Secondly, there will ensue paralysis of the muscular fibres of the middle coat. Thirdly, the nutrition of the intima will be disturbed, giving rise to cloudy swelling of the cells, loss of smooth surface, and then, as a consequence of the roughened wall presented to the passing blood, coagulation of the fibrin and the formation of a thrombus. As the change is sudden, the blood coagulates quickly, and a clot is formed which is non-laminated, and commensurate with the extent to which the vessel-wall is affected. The pus formed gradually finds its way to the surface, points, and escapes either by natural or by artificial means. That the pus found its way inwards was long believed, and the clot was spoken of as a 'suppurative' thrombus, in the belief that pus actually existed in the thrombus. At most the thrombus presents only a puriform appearance, and pus is not now believed to get from without to within a vein. The adhesion between the wall and a thrombus so formed is very loose, and easily disturbed; the consistence of the thrombus itself is loose, its tissue friable and easily broken up; and, as a consequence, particles may become detached and washed into the blood-stream, forming emboli. *See* Embolism; and Thrombosis.

Symptoms.—(*a*) *Endophlebitis*, or adhesive phlebitis, being for the most part a local disease, few constitutional symptoms are present. The vein becomes hard, swollen, and tender; opposite the valves distinct prominences occur where the blood has first become stagnant; the limb becomes stiff; and sharp, shooting, darting pains occur along the course of the vessel. The train

of symptoms will vary according as the veins are superficial or deep. If they are superficial, the veins can be felt beneath the skin; the skin over them is of a livid red hue; and there is but little œdema of the tissues. If, on the other hand, deep veins are affected, the results will vary according as the phlebitis involves the main venous trunk or the veins of secondary importance. Should the main venous trunk become blocked, as in phlegmasia dolens, the whole limb is swollen, the skin is pale, the superficial veins become obscured, and the extremity affected is tense and heavy. Should it be other than the main venous trunk that is affected, say the tibial instead of the common femoral, the part becomes hard and swollen, the superficial veins are full and prominent, but there need be no extensive superficial œdema in either case. The constitutional symptoms are, so long as the disease is localised, but slight; should, however, pus form, or the clot break down, pyæmia and embolism may occur and lead to a fatal result.

(*b*) *Periphlebitis*, or suppurative phlebitis, occurs only when a person who is the subject of visceral disease, or who is exposed to bad hygienic conditions, suffers some local injury. The inflammatory condition, and it may be the pus formed, can be followed along the course of the vein, until it develops in some part where the connective tissue is looser than elsewhere. Here an abscess rapidly forms; the vessel is swollen and hard; the tissues become œdematous for some distance below the inflamed spot in the vein; and the pain, at first of a shooting character, becomes throbbing as pus forms. The constitutional symptoms are of a typhoid character: a feeble fluttering pulse, foul mouth and tongue, irritable stomach, diarrhœa, fœtid breath, with muttering delirium. The majority of such cases die. The disease is only a part of pyæmia. *See* Pyæmia.

*Gouty phlebitis* is a name assigned to a condition rather than to a disease. There is a tendency in persons suffering from gout to develop adhesive phlebitis; and when varicose veins exist in a gouty person, they are especially the seat of the changes that go by the name of gouty phlebitis. Whether it is the vein itself or the overlying structures that are attacked, it is impossible to say, the symptoms in each appearing together. The skin over the vein becomes of a dusky, or at times of a livid red hue, for some distance around; the vein may be felt to be hard; the limb is slightly œdematous; the temperature of the part is but little, if at all, raised; and the pain is not troublesome. The disease is peculiar, inasmuch as all the symptoms may disappear from one part and appear in another. Its apparent metastases, its indefinite symptoms, and its troublesome recurrences, have gained for this disease the epithet 'gouty.' The evidence derived from the treatment, however, with regard to the pathology of this disease, rather negatives its gouty nature, and points to a condition of loss of tone, associated with local erythema.

Diagnosis.—Inflammation of the veins has to be diagnosed from inflammation of the lymphatics, and from erysipelas. In the case of the lymphatics, the glands are tender and enlarged from an early period of the disease, the streaks are rosy-red and in large numbers; in erysipelas, the redness is a general blush. But it must be remembered that both of these conditions are associated with phlebitis, and that all tend towards pyæmia.

Prognosis.—In endo- or adhesive phlebitis, the prognosis, in regard to the thrombus, is that it will be gradually absorbed, or that it will become incorporated with the wall of the vein, and reduced to a cellular cord. In regard to the walls of the vein, they may return to their normal state, remain permanently thickened, become adherent to the thrombus; or the cellular cord, formed by the remains of vessel-wall and thrombus, may become perforated, allowing blood again to flow through it. In peri- or suppurative phlebitis, the prognosis is bad, in regard both to the life of the patient, and the recovery of the vessel.

Treatment.—In all forms of phlebitis we must insure absolute rest by confining the patient to bed, and by fixing the whole limb between sandbags, or by means of splints. This is essential to procure diminution of pain, and to lessen the chance of breaking off a fragment of the clot, whereby fatal embolism might be caused. Hot fomentations are by far the most agreeable and soothing application. When abscesses form, poultices are required; and to remove hardness, after acute symptoms are gone, salt and nitre poultices are useful. When abscesses form they must be opened. Any œdema or general thickening that may remain must be combated by Martin's elastic bandages. Medicines, except those given to support the patient's strength, such as bark and ammonia, and the like, are not indicated. Calomel and opium are not administered now as they once were, as a specific to resolve the clot and restore the vein. Opium is given only to allay pain, and the less the drug is used for that purpose, so much the better chance has the patient of recovery. The treatment of peri-, suppurative, or diffuse phlebitis is to be conducted at first on the same principles, but the further treatment is discussed under pyæmia. *See* Pyæmia; and Thrombosis.

2. **Varicose Veins.**—Synon.: Varix; Phlebectasis; Fr. *Varice*; Ger. *Krampfader*.

Definition.—Veins which are increased in length, diameter, and thickness.

Ætiology.—As the current in the veins is dependent on a free and sufficient circulation through the heart, the arteries, the capillaries, and the veins themselves, whatever interferes with the passage of blood through any of these will predispose to varicosity. Hence feeble action of the heart, obstruction of the current of blood in the arteries, the involvement of the capillaries in any inflamed or thickened mass of indurated connective tissue, will check the free passage of the blood, and so withhold the *vis-a-tergo* necessary for driving the blood along the vein. In consequence, the blood-current in the veins will be retarded, and the increased pressure on the vessel-wall will cause dilatation. In the veins themselves the onward current may be impeded by a tight garter, the pressure of a tumour, aneurismal varix, the pressure of a truss, a full rectum, a gravid uterus, dilatation of the right

heart, emphysema, and prolonged standing. A person engaged in any employment that necessitates much standing, and especially when in addition there is leaning forwards, as over a counter or a wash-tub, throws most of the strain on the muscles of the calf. The continued use of these muscles will cause a determination of blood to them, and by-and-by the full current in the vein will exhaust the resisting powers of its wall, and allow of its dilatation; so that from the surfaces of the soleus and gastrocnemius, several enormous veins will be found to emerge.

Anatomical Characters.—The principal seats of varix are the extremities, especially the lower limbs; the body, when collateral circulation is set up by blocking of the venous trunks; the rectum (*see* Hæmorrhoids); and the scrotum. *See* Varicocele.

The morbid changes in the development of a varicose vein occur in the following stages:—

*a.* Simple dilatation of a vein occurs when excess of strain is thrown on its walls from any obstruction.

*b.* This may be of so long duration that actual changes in the structure of the wall ensue. These consist in a hypertrophy of the muscle-cells in the middle coat, and a hyperplasia of the connective tissue in all the coats.

*c.* Should the cause of the dilatation continue, the vessel becomes thicker, increases in length, and, as a consequence, becomes tortuous, wavy in its outline, and irregular in its calibre.

The valves, in harmony with the vessel-wall, become hypertrophied, and for a time perform their function; but by-and-by they are insufficient to span the widening stream, and as they become useless, are reduced to fibrous cords. Behind the valves the blood finds a quiet recess, where it frequently stagnates, and a thrombus is formed, which may remain as a partially obstructing thrombus, or by continual additions to its surface, become a completely obstructing thrombus. After long-continued dilatation the tissues around thicken, and the fibrous tissue formed will spread between outlying tissues, and, involving the blood-vessels, will encroach on their calibre and strangle them. In this way it is that the vessels of the skin over a varicose vein are destroyed, and by the removal of the skin an ulcer is formed. *See* Ulcer.

*d.* The vein, as it approaches the surface, may by its pressure cause thinning, instead of thickening, of the surrounding tissues; and its walls finally become thinned and ruptured. In consequence an enormous quantity of blood may be lost; and unless means are employed to arrest its flow, fatal effects may ensue.

Symptoms.—The premonitory symptoms of varicose veins in the lower extremities are but ill understood. Numbness, cramps, increased heaviness of the limbs, occasional swelling about the ankles and feet precede the actual appearance; but these symptoms might be the forerunner of other troubles, and not of varicose veins at all. It is not until the vein is seen to be varicose that the disease can be known to exist. When first seen, a small part of a superficial vein, usually about the calf or ankle, looks slightly more bluish and larger than usual. This may disappear or escape observation for some time, only, however, to recur; and by-and-by the condition will become permanent, with occasional shooting pains in the course of the vessel. The superficial veins may become wholly involved, either from below upwards, or from above downwards, according to the seat of the obstruction.

The superficial may be equally involved with the deep veins. As a consequence the whole limb is abnormally large; a solid œdema permeates all its parts; the nutrition of the limb is interfered with; and the superficial parts giving way, profuse hæmorrhage or the formation of a varicose ulcer may be the result. The hæmorrhage is at times excessive, the blood pouring from the upper instead of the lower end of the vessel. This anomaly is accounted for by the destruction of all the valves between the ruptured spot and the heart; the increased pressure, in this long column, relieving itself by the aperture at its lower extremity.

Diagnosis.—Varicose veins are unmistakable in their appearance as usually found. At times a saccular dilatation of the internal saphena vein, just below Poupart's ligament, is mistaken for a femoral hernia; but with ordinary care this is to be made out easily.

Prognosis.—A dilated vein is dangerous according as it has a tendency to rupture or become inflamed. Either of these complications may prove fatal. The chance of an extensive group of varicose veins becoming obliterated, whether by spontaneous cure or by operation, is but slight.

Treatment.—The treatment in any particular instance is to find out the cause of the veins becoming varicose, and to remove it if possible. The circulation in the dilated vessel must then be encouraged, by obtaining a good cardiac and vascular tone; by support of the blood in the vein; and by particular attention to dietary and hygienic rules for some time. The vein is best supported by an elastic stocking, or by Martin's elastic bandage, or by an ordinary roller-bandage carefully applied. The position of the limb must be attended to, so as to help the venous return; the patient sitting with the feet raised on all possible opportunities, and not neglecting at night to sleep with the lower end of the bed slightly raised. Rules of treatment such as these are no doubt beneficial, but, unfortunately, are but seldom curative. For the purpose of cure by obliteration of the vessels, numerous plans are practised. The cases in which it is considered justifiable to operate are (1) when the vein gives rise to pain and inconvenience; (2) when hæmorrhage threatens or recurs; (3) when ulceration threatens; (4) when œdema is great; (5) when a varicose ulcer will not heal.

The methods practised may be briefly noticed.

*a.* At two or three spots over the varicose vein, the skin is touched with caustic potash, nitric acid, or a paste consisting of five parts oxide of calcium, four parts caustic potash, with spirits of wine to the proper consistence.

*b.* Two or three drops of perchloride of iron may be injected into the vein. The blood at the part injected must be rendered stagnant by compression above and below.

*c.* Needles may be introduced through the vein, and a galvanic current passed along them.

*d.* Subcutaneous division may be practised, by introducing a narrow pointed bistoury beneath the vein, and dividing it.

*e.* The varix may be compressed, by passing a hare-lip pin beneath the vein, opposite the highest point at which obliteration is wished, and taking care not to transfix the vessel. A piece of wax bougie must next be laid over the pin lengthwise on the vein. The practitioner then twists a piece of silk over the ends of the pin, figure-of-8 manner, so as to cause the bougie to be pressed on the vein and pin. At intervals of an inch along the vessel the process is repeated as often as it is necessary, so as to obliterate the whole vein. The part must now be kept absolutely at rest, and the pins left in position for eight days.

In all these methods, the risks of phlebitis, thrombosis, and their consequences are to be remembered and well weighed, before an operation is undertaken. The result in regard to the vein operated on may be a permanent cure, but it is almost certain that the neighbouring veins may become varicose in a few months.

**3. Hypertrophy of Walls.**—This takes place when extra work is thrown on the walls of the vessel. *See* Varicose Veins.

**4. Atrophy.**—When from any cause a vein, or part of a vein, falls into disuse, as after an amputation, its calibre-diminishes, and its coats atrophy until it finally disappears.

**5. Degeneration.**–That atheroma of the coats of a vein takes place is not determined. The calcareous plates found at times in the saphena veins, inferior vena cava, and uterine veins are probably a form of phlebolithes, and do not originally proceed from the wall of the vein.

**6. Phlebolithes.** — Phlebolithes, or venous calculi, have a tendency to form in veins in which, from dilatation of the coats, the circulation is abnormally slow, as in the veins of the prostate and bladder, and in varicose veins anywhere. They commence no doubt as precipitated fibrin, and to this is added the less soluble salts of the blood—chiefly phosphate of lime, and in less quantity the sulphate of lime and sulphate of potash. Phlebolithes are harmless, and they require no treatment.

**7. Wounds, and process of healing.** *Wounds.*—When a healthy superficial vein is wounded, dark venous blood flows in a uniform stream from the distal end; but in the case of a varicose vein the blood flows from both ends, and chiefly from the cardiac. At the same time a quantity of blood escapes into the subcutaneous areolar tissue, and around the sheath of the vein. When a deep vein is wounded with a breach of surface, dark, scarcely fluid, blood oozes and trickles away. When a deep vein is torn by a broken bone, without breach of surface, the part around swells, and becomes dark in colour; œdema occurs around and below the torn vein; and, according to the amount of the extravasation, and the condition of the patient and the part, so will there be a tendency to resolution, non-union or delayed union of the bone, excess of callus, or the formation of pus, followed by osteophlebitis, pyæmia, and moist gangrene associated with bullæ.

*Healing process.*—When gentle pressure is applied over the wound after venesection, and the limb is kept at rest, union takes place in a few days, so that no scar even can be found in the injured vein. The coats of a vein contract and retract only to a slight extent within the sheath, but still sufficiently to help in the arrest of the hæmorrhage and the formation of the clot. The extravasated blood coagulates, extends through the opening in the vein, and projects like a button into the blood-stream. The whole coagulum now contracts; the part projecting into the vein becomes organised; and finally helps to close the wound. No inflammation is necessary, no cicatrix is left, and the vessel is not obstructed. Instead of this favourable ending, there may arise, from excess of movement or inflammation, numerous troubles, such as complete obstruction of the vein, phlebitis leading to thrombosis and the dispersion of emboli, local suppuration, inflammation of the lymphatics, or pyæmia.



Treatment.—Hæmorrhage from a superficial vein is readily arrested by pressure over the wound, and elevation of the limb. In the event of persistent hæmorrhage occurring from a deep vein after the employment of pressure, elevation, and styptics, the vessel must be cut down upon and ligatured. When a large vein is pricked, and the hæmorrhage cannot be checked by ordinary means, the margins of the opening in the vein may be seized with a forceps, and tied with a catgut ligature.

**8. Air in Veins.** *See* Veins, Entrance of Air into.

**9. Parasites.**—The embryos of the Tænia and the Bilharzia hæmatobia are occasionally found in the blood of the portal vein; the latter are also found in the veins of the bladder. *See* Bilharzia.

**10. New Growths.**—Tumours do not originate in connection with veins, but the current may get checked or stopped by tumours in the neighbourhood. For venous nævi *see* Tumours—*Angiomata.*

James Cantlie.

**VEINS, Entrance of Air into.**—Synon.: Fr.: *Aérhémoctonie*; Ger. *Lufteintritt in die Venen.*

The fact that animals could be killed by injection of air into the veins had been known since the middle of the seventeenth century, but the first case of spontaneous entry of air in man was not recorded till 1707, by Merz. After that time numerous observations were made on animals by Nysten, Bichat, Magendie, and others, in order to ascertain the cause of death, and the conditions under which it occurred. In the present century the subject has been investigated by Amussat, Erichsen, Pirogoff, Bouillaud Brek, Panum, Fischer, and many others.

Anatomical Characters.—The air is found in the right auricle, often greatly distending it. In the whole right side of the heart it is usual to find a frothy mixture of blood and air. Bubbles of air are also found in the pulmonary artery, even in some cases in the smaller subdivisions.

Pathology.—The result of the investigations respecting the entrance of air into veins may be summed up briefly as follows:—

**1. Amount of Air necessary to Cause Death.**—This varies with the size of the animal

experimented on, and the mode of injection of the air. A small animal requires a smaller amount of air to cause death than a large one. If slowly injected, enormous quantities may be pumped into the veins with impunity; while a quantity sufficient to fill the auricle, injected suddenly, is certainly fatal. Recovery may take place after the occurrence of very serious symptoms, and on the other hand death may occur after an interval of some hours or even days.

2. **Causes of the Spontaneous Entry of Air into a Wounded Vein.**—In inspiration the diminished pressure within the thorax causes just the same tendency for the blood in the large veins at the root of the neck and the axilla to rush into the right auricle, as there is for the air to enter the lungs by the trachea. This aspiratory force does not extend beyond the veins mentioned, and the region in which they lie is often called 'the dangerous region.' If the vein be completely divided, its lax walls fall together, and thus offer a valve-like resistance to the entrance of air; but if in any way the opening be kept patent, air will rush in at each inspiration. The opening may be kept patent by a diseased condition of the walls of the vein, as when it passes through a tumour, or is imbedded in inflammatory products; or the surgeon may pull open a half-divided vein by traction on the parts he may be removing; or the aperture may be circular, as when a small piece is cut out of the wall of the vein, or a branch is cut off close to the main trunk. The external jugular, if divided low in the neck, remains open, on account of its connection with the cervical fascia. Gas formed in the uterus, as the result of decomposition of clots left in its cavity after labour, is said in some rare cases to have got up sufficient pressure to force its way in at the open mouths of the placental veins, and thus cause death.

Symptoms.—As the air enters the opening it gives rise to a noise variously described as hissing, whistling, or lapping. If the patient be not under the influence of an anæsthetic, he cries out that he is dying, or makes use of some expression indicative of great distress. He becomes immediately pale and faint. There is intense anxiety, with the most severe dyspnœa. The dyspnœa is purely cardiac in origin, the air entering the lungs freely, with violent and hurried inspirations. The sense of want of breath is due to an interruption of the flow of blood through the lungs. The pupils are usually widely dilated. Although the patient is pale and faint, the action of the heart may at first be felt through the chest-walls to be violent and irregular, and it is said that on auscultation a peculiar churning sound may be heard. The pulse rapidly becomes weak. Convulsions have occurred in some cases, of a tetanic character; and in some violent coughing has also been noted. If a large quantity of air has entered, death may be almost instantaneous. If a small quantity only has been sucked in, the patient may recover, sometimes after some hours or days of distress; and occasionally a fatal termination may take place a considerable time after the accident. Greene (*Amer. Jour. of Med. Science*, xciii. p. 38) has collected 68 cases. Amongst these 24 died almost immediately; others died from three hours to seven days after the accident. In the cases that survived some days bronchitis supervened, and possibly the entrance of air may not have been the real cause of death.

There can be no doubt that death results from arrest of the pulmonary circulation. It is not from paralysis of the heart, as some have said, for the cardiac action continues long after the air has entered. The heart is constructed to pump onwards a fluid which, like all other fluids, is incompressible. If the right ventricle be filled with air or a frothy mixture of air and blood, a considerable part of the force of its contraction will be wasted in merely compressing the air instead of driving it on. This, however, is but a small factor in the arrest of the circulation; the chief cause being that the air, or frothy mixture of blood and air, fails to work the valves. For the pulmonary valves to act it is necessary that the artery should be filled and its coats stretched; but here we have the vessel only partly filled, and that with an elastic gas instead of an incompressible fluid. Its coats are but slightly stretched, and the valves probably lie flat against them, and are not closed by the current of air or froth regurgitating after the ventricular contraction has ceased. The tricuspid valve probably also fails to act. The want of blood in the lungs causes the sense of dyspnœa; and the flow through the lungs having ceased, the left side of the heart will become empty, and no blood reaching the brain, faintness, followed quickly by death, naturally occurs. Supposing the patient to recover, the air which may have got into the circulation, is absorbed by the blood.

Treatment.—The accidental entrance of air into the veins must be prevented by careful operating. If a vein can be seen to be in danger it is advisable to compress it on the proximal side. If it is necessary to divide it, a double ligature must first be applied. If the symptoms described should appear, a finger must be at once placed upon the wounded vein. The indications then are: 1. To get the air out of the auricle; 2. To fill the auricle with blood; 3. To keep up a supply of blood to the brain. To empty the auricle the finger must be kept on the opening in the vein during inspiration, but removed during expiration, and at the same time the chest should be forcibly compressed. By these means frothy blood and air may be made to escape in considerable quantities from the opening. This is recorded as having occurred during the violent expiratory efforts of coughing that sometimes accompany this accident. To try to suck out the air by means of a tube inserted (as has been recommended) into the right jugular vein, would probably only ensure the patient's death. The auricle may be filled with blood by applying friction to the limbs in an upward direction. In order to ensure the flow to the brain of what little blood may be leaving the left side of the heart, it has been recommended to compress the abdominal aorta and the subclavian arteries. The veins being uncompressed can empty themselves into the auricle, which thus may be filled with sufficient blood to work the valves, and so restore the circulation. Should the respiration fail, it is advisable to try artificial respiration; but if the case

reaches that stage, there can be but little hope of recovery, as it is not want of air in the lungs that causes death, but want of blood in the pulmonary vessels. Those who are interested in the subject will find references to the literature in Fischer's lecture, 'Ueber die Gefahren des Luftеintritts in die Venen während einer Operation,' *Volkmanns Sammlung Klinischer Vorträge*, Series iv. No. 113. MARCUS BECK.

**VENEREAL DISEASES.**—A common term for all forms of contagious disease usually contracted and transmitted by impure sexual intercourse. There are three principal kinds of venereal disease; namely, *gonorrhœa*, *syphilis*, and the *local venereal sore*, or *chancre*. *See* GONORRHŒA; SYPHILIS; and VENEREAL SORE.

**VENEREAL SORE.**—SYNON.: Local, soft, non-infecting Chancre or Sore; Fr. *Chancre Mou*; Ger. *Schanker*. Clerc employed the term *chancroïde*, which, modified into 'chancroid,' has been adopted by many American authors.

DEFINITION.—A virulent, local, contagious ulcer, communicable only by contact of its pus with a breach of surface.

ÆTIOLOGY.—The ætiology of the local chancre is still a subject of dispute. Those who are now known as *unicists* maintain that it is connected with syphilis. Others believe that it may be caused by the products of simple inflammation. But the most generally received opinion, and that which is most in accordance with the present state of our knowledge on the subject, is that the local or soft chancre is due to a virus, distinct from that of syphilis; that it never gives rise to any special constitutional symptoms; and that its effects are limited to the neighbourhood of the sore itself, and the nearest lymphatic glands. It is from this so-called *dualist* point of view that the present article is written.

**Contagion.**—The local chancre, like syphilis, may be communicated by direct or by mediate contagion, but is of course never transmitted by inheritance. Syphilis is not infrequently conveyed in various ways independent of sexual intercourse (*see* SYPHILIS). The local chancre, on the other hand, is very rarely other than a venereal disorder; chiefly because, not being part of a general disease, it does not give rise to contagious lesions on distant parts of the body.

The disease may also be conveyed from one person to a third, through the medium of one whose cutaneous or mucous surface happens to be intact, and who thus escapes inoculation.

One attack of the local chancre, unlike syphilis, affords no protection for the future; hence the same person may suffer as often as he exposes himself to contagion.

DESCRIPTION.—When chancrous pus is inoculated artificially, the puncture within twenty-four hours becomes surrounded by a faint red blush; on the second day the redness extends, and the site of inoculation becomes swollen. On the third day a vesicle appears, and rapidly becomes a pustule. About the fifth day the pustule bursts, leaving a circular ulcer with well-defined, sharply cut edges; the surface of the ulcer is uneven and spongy, presenting a worm-eaten appearance; and the base is soft and surrounded by a pink areola.

*Varieties.*—In the most characteristic form of sore the ulceration involves the whole thickness of the skin or mucous membrane, and its characters are essentially those of the typical form produced by experimental inoculation. The edges of the sore are loose and often undermined. In another variety the characters are ill-marked. The sore is superficial, the edges are not undermined, and the discharge is thinner and less abundant than in the typical sore. What has been termed a third variety results from exuberant growth. The surface is raised above the surrounding parts by the development of prominent granulations; hence the term 'fungating sore,' or *chancre vegetante* of French writers.

In all varieties of local chancre the base is supple unless inflammation is present, in which case there is more or less thickening of the surrounding parts. The discharge is readily autoinoculable, hence a plurality of sores is very common.

The *seat* of the local chancre is nearly always the genital organs or their immediate neighbourhood. A primary sore on the body of the penis is much more likely to be syphilitic than local.

The *form* of the local chancre varies in some degree according to its position. Thus, in the furrow behind the glans penis, the sore is elongated; about the frænum, in the folds of mucous membrane around the anus, and about the female genitals it is fissure-like. Again, when exposed to the air and neglected, it may become covered by a scab. If chancrous pus gain entrance to a follicle (follicular chancre) the latter may become distended, and temporarily simulate a small abscess.

As regards *size*, uncomplicated local chancres do not usually exceed half an inch in diameter, unless two or more run together, in which case they form a large irregular ulcer. Such confluent chancres are more common in women.

COURSE, DURATION, AND TERMINATIONS.—The regular course of the local chancre usually occupies from four to eight weeks; but the superficial form may heal in a few days. This course is divided into three stages: (1) an increasing, (2) a stationary, and (3) a healing stage. The length of each is liable to vary from many causes. Roughly speaking, however, it may be said that the first period, during which the sore sensibly increases in size, occupies from a week to a fortnight; that the second lasts about a fortnight; and that at the end of from three to five weeks, the stage of repair is reached.

By appropriate treatment the duration can generally be greatly shortened. It is also much influenced by the position of the sore. Thus, at the orifice of the prepuce or urethra, the irritation of the urine retards healing, and phimosis acts in a similar manner. Chancres of the frænum, again, often continue to spread until they have destroyed it. In fact, the more mobile and exposed to irritation is the part, and the greater the difficulty of keeping the dressings in place, the longer will be the duration of the sore.

If the syphilitic poison have been inoculated as well as chancrous pus—a frequent occurrence—the course of events will remain uninfluenced,

until the incubation-period of syphilis has elapsed; when if the sore be still unhealed, it will gradually change in appearance by the development of induration at its base, until finally it assumes the characters of the initial manifestation (*see* Syphilis). If, on the other hand, the local sore has healed before the end of the period of incubation proper to syphilis, the scar will become indurated, and erosion or ulceration will probably, though not necessarily, follow.

Complications.—The less serious complications of the local sore include *inflammation*, *phimosis*, and *paraphimosis*.

*Phagedæna.* — This graver complication of chancre may be either acute or chronic; and may attack the original sore, or the consecutive bubo, or both.

In a typical case of *acute sloughing phagedæna* the patient is usually much depressed. He soon becomes feverish, with a dry, brown tongue, quick pulse, and other signs of constitutional disturbance. The discharge from the sore diminishes, is thin, sanious and shreddy, and very offensive. The margins of the ulcer are puffy and livid at first, but soon become black and ragged, presenting a 'gnawed' appearance. As the process goes on the dead tissues separate in sloughs, which vary in size according to the rapidity of the destruction. In the most severe cases necrosis is very rapid, and attended by excruciating pain. The whole of the genital organs in either sex may thus be destroyed; while, if the groin be the seat of phagedæna, the great vessels and nerves are quickly exposed at the bottom of a deep ragged cavity. If the process be not soon checked, death may occur from hæmorrhage, from exhaustion, or from some acute intercurrent inflammation.

The course which has just been described is that of the worst form of phagedæna, which is now fortunately rare; but less severe examples, ranging in various degrees between that described and those where a sore simply becomes larger, inclined to spread, looks unhealthy and has 'gnawed' edges, are common enough in venereal practice.

In the *chronic form* of phagedæna (serpiginous ulceration) the morbid process is much less active, and is not usually attended by much pain or constitutional disturbance, at least at first. The sore spreads gradually, but the tendency is rather to extend widely and superficially than deeply. The groin is the most usual seat of serpiginous ulceration, whence it may extend upwards along the abdominal wall or down the thigh, laying bare the deep fascia, and dissecting out the superficial vessels and nerves. It often also undermines the skin extensively, before destroying it; hence the loose and irregular margins of the ulcer are detached from the deeper parts for a considerable distance. The duration of this form of ulceration is very variable. It often lasts for months and sometimes for years; at one time appearing to be stationary, while at others it spreads in one direction and heals in another. After a time the patient's health suffers more or less severely, and finally he may become exhausted by the constant and prolonged irritation and discharge. If he recover, he may be permanently crippled by the contraction of the resulting cicatrices.

The causes of phagedæna are not yet fully understood. Some of the worst cases no doubt occur in persons whose constitutions have been broken by debauchery, syphilis, starvation, &c., but in other instances the patients are, to all appearance, healthy.

*Bubo.*—This complication, which is much less frequent in women than in men, is said to occur in about one-third of the total number of cases of local chancre, but this is probably too high an estimate. It may be either *simple* or *virulent*, the former being most common.

*Simple or sympathetic bubo* arises from ordinary irritation, and is similar to that caused by simple irritation of any other kind.

*Virulent* (*chancrous*) *bubo* is due to the conveyance of chancrous matter from the sore along the lymphatic vessels to the gland.

*Bubon d'emblée.*—This term has been applied to a variety of bubo, believed by some authors to result from the absorption of chancrous pus and its conveyance to a lymphatic gland without the production of any lesion at the point of inoculation. The existence of such a bubo is not yet established beyond doubt. *See* Bubo.

*Lymphangitis.*–This, like bubo, may be simple or virulent, but is a less frequent complication of the local chancre. Bubo of either kind may, and frequently does, exist without any perceptible change in the lymphatics leading to it; but when the vessels are affected the glands are usually inflamed also. The thickened lymphatics can be felt as tender and often irregular cords, and their course is generally marked out by red streaks along the surface.

Simple lymphangitis may end in resolution, or one or more abscesses may form along the course of the vessel. The virulent form probably always goes on to suppuration, and the resulting sores become chancres in every respect similar to the original one.

Diagnosis.—The local chancre in its ordinary forms is recognised by the characters which have been already mentioned, and which are recapitulated in the following table, where also they are contrasted with those of the initial manifestation of syphilis—the lesion to which by far the most importance attaches from a diagnostic point of view.

| *Local Chancre.* | *Initial Manifestation of Syphilis.* |
|---|---|
| 1. A local and nearly always venereal disorder, produced only by the pus of a similar ulcer. | 1. The first sign of a general and not necessarily venereal disease: it may be produced by the secretion of any syphilitic lesion or by the blood during the earlier stages of the disease. |
| 2. No period of incubation. Irritation begins within a few hours after contagion. | 2. Always a period of incubation, which averages 24 days. |
| 3. Begins as a pustule which soon bursts, leaving an excavated ulcer with sharply-cut, loose, often undermined edges, and an irregular spongy floor of a dirty yellow colour. | 3. Begins as a slightly elevated papule or erosion. Ulceration may be absent throughout. Edges raised, adherent, and rounded. Surface smooth and often of a ham-red colour. |
| 4. Base supple unless inflamed, in which case it becomes hard like that of a boil; the hardness is diffused, resistent to the touch, ill-defined, and fades gradually into the surrounding tissues. | 4. Base more or less indurated. The hardness is sharply circumscribed, somewhat elastic to the touch, and independent of acute inflammatory action; it varies much in amount, being sometimes superficial and scanty, and feeling like a thin layer of parchment or paper; sometimes abundant, and feeling like a mass of cartilage. |
| 5. Discharge abundant, purulent, and freely inoculable on the bearer as well as on others. | 5. Discharge scanty, serous, and not auto-inoculable unless suppuration be produced. |
| 6. Inoculability on certain animals possible. | 6. Inoculability on animals doubtful. |
| 7. Usually multiple. | 7. Usually single. |
| 8. Very rarely seen far away from the genital organs. | 8. Not very infrequent on the lips or fingers, and on the breast in women. |
| 9. Course acute, and attended by pain. | 9. Course chronic. Pain frequently absent. |
| 10. Duration greatly influenced by local treatment. | 10. Duration usually depends on general specific treatment. |
| 11. Inflammation and phagedæna not uncommon. | 11. Inflammation and phagedæna rare. |
| 12. Glands remain unaffected or become acutely inflamed. Suppuration common. Bubo may be simple or virulent. Only one or two glands suffer. | 12. Adenopathy constant, indolent, and nearly always multiple. Suppuration rare. Bubo never virulent. |
| 13. Never causes general infection of the system. | 13. Is followed by constitutional symptoms. |
| 14. Repeated attacks common. | 14. A second attack rare. |

While the characters given in the foregoing table are amply sufficient for the diagnosis of the two lesions in uncomplicated cases, it must be mentioned that the appearance of either sore may be altered in various ways, for example, by neglect of cleanliness, or by the application of irritants. Thus the local chancre may develop an amount of inflammatory thickening which cannot for a time be diagnosed from that produced by similar causes in the syphilitic initial lesion; for the specific induration may become masked by inflammation. In such cases a positive diagnosis must be postponed until the irritation has subsided. Again, even if a patient present himself with a typical local chancre, it is of course not certain that the syphilitic poison has not been imbibed as well; and the incubation period of syphilis must be allowed to elapse before the patient can be assured that his trouble is only local. Further, as regards the two most characteristic signs of primary syphilis, namely, induration of the base of the sore, and indolent multiple enlargement of the nearest lymphatic glands, these are merely signs of a general disease, and one or other may be ill-marked, or even absent, or at least inappreciable. Then, as regards number—the initial lesion of syphilis may be multiple if several abrasions happen to be inoculated; and the local chancre may be single, especially in persons of careful and cleanly habits. Inflammatory action also may mask the usually separate indolent glands; but apart from this, sometimes only one or two glands can be felt. This is most often the case when the glands have been spoiled by previous inflammation. Absence of enlargement also appears to be sometimes due to the pressure of a truss. In very fat people again the glands cannot always be felt.

Thus, in making a diagnosis, not one but all of the signs that may be present, together with the history of the case, must be taken into consideration; and if the diagnosis still remains doubtful, the case must be watched until conclusive evidence is forthcoming.

*Auto-inoculation* is sometimes of service in diagnosis, but in the present instance would not be of much value; for even if a typical local chancre were the result, syphilis could not be excluded until the incubation period had elapsed.

When an immediate diagnosis is imperative, the so-called *confrontation*, or comparison of the patient with the source of his disease, may set the question at rest; but many precautions are necessary in drawing conclusions from such evidence.

*Ulcerating syphilides*, especially mucous patches of the female genitals, occasionally resemble the local chancre, but the presence of other signs of syphilis would lead to a correct diagnosis.

*Gummata* about the genital region, in both sexes, after breaking down, sometimes leave

ulcers which have a remarkably close resemblance to local chancres.

Besides syphilitic affections, there are a few others which require to be mentioned in connection with the diagnosis of the local chancre. *Herpes* is characterised by vesicles, or small and very superficial erosions grouped together on an inflamed area. Itching or smarting also often precedes an attack of herpes, and there is frequently a history of previous attacks, which, again, are often independent of any suspicious sexual exposure, and are liable to recur at regular intervals, or in connection with digestive disturbance. Herpes also disappears in a few days under measures of simple cleanliness, and the discharge is not auto-inoculable.

*Simple abrasions* are irregular in form, are usually noticed by the patient at the time of their production or very soon afterwards, and heal readily in a few days if they are not irritated. Both herpes and abrasions, however, as well as the erosions due to balano-posthitis, may, under irritation of various kinds, become suppurating and inflamed ulcers, which for a time are very difficult to distinguish from local chancres.

When *phimosis* prevents exposure of the parts, a discharge from beneath the prepuce may be due to several other causes besides the local chancre, for example, syphilis, gonorrhœa, balanitis, or warts. If the local chancre be present, its site is usually indicated by the presence of a tender spot in that situation, and pressure often causes a slight oozing of blood. Consecutive sores also quickly appear at the margin of the prepuce. In the case of *syphilis*, the presence of induration and the multiple indolent enlargement of the inguinal glands will usually render the diagnosis clear. In *gonorrhœa*, soreness of the deeper urethra, scalding during micturition, the presence of chordee and other signs of urethritis, and the absence of localised tenderness beneath the swollen prepuce, are points that will usually determine the nature of the case. In *balanitis* there will be an absence of circumscribed tenderness and of signs of urethritis. *Warts* can be felt through the prepuce, and a portion of the growth can usually be seen by putting the parts on the stretch.

In all these cases also, when the source of the discharge is doubtful, auto-inoculation may be practised, though it is rarely necessary.

Prognosis.—The prognosis of the uncomplicated local chancre is always favourable. If any complication arise, the prognosis will of course depend upon the nature and severity of the complication.

Treatment.—The treatment of the local chancre consists chiefly in the employment of local remedies; the general treatment being directed, on ordinary principles, to the maintenance of the patient's health, by tonics, regulation of the diet, moderation in, or abstinence from, alcohol, and as much rest as possible, in order to diminish the risk of complications.

A local chancre of only a few days' duration can generally be destroyed by one thorough application of heat or caustic. The advantages of such a mode of procedure are that (*a*) consecutive inoculation, and consequently multiplicity of sores, is prevented; (*b*) the risk of bubo and of other complications is much diminished; and (*c*) the duration is greatly shortened.

When the surface is large, or when the sores are numerous, destructive measures should only be employed when milder ones have failed.

The thermo-cautery is the most convenient form of actual cautery. For the treatment of small sores, caustics are least alarming to the patient; strong nitric acid, and the mixture of charcoal and sulphuric acid commonly known as 'Ricord's paste,' are the most suitable forms. Before using either caustic or cautery the following two points should be borne in mind, viz.:— 1. No sore should ever be cauterised unless *the whole* of the diseased surface can be acted on. 2. The surrounding parts must be cleansed with carbolic lotion or other disinfectant, lest subsequent re-inoculation occur from any discharge that may be present.

When caustics are not used, the best application is iodoform, of which the *powdered* crystals may be sprinkled on the sore by means of a quill, or applied with a moistened camel's-hair brush twice or thrice daily, according to the amount of discharge. The sore should then be covered with a piece of lint or wool, and if the dressing cannot be kept in place by the natural conformation of the parts, a piece of oiled-silk and a narrow strip of bandage or plaster should be applied. Iodoform may also be applied as an ointment with vaseline, or with glycerine, or an ethereal solution may be painted on the part, a thin coating of iodoform being left after the evaporation of the ether.

If iodoform is not used, a lotion of sulphate of zinc, lead, tartarated iron, or nitrate of silver may be applied, according to the state of the ulcer. Whatever dressing is employed, care must always be taken to change it frequently, and to arrange it so that opposed surfaces are kept apart. Chancres beneath a phimosed prepuce must be treated by frequent injections, with a syringe having a long nozzle, of carbolic lotion (1 in 40), or acetate of lead. Any of the sores that are within reach should be dressed with iodoform, and a piece of absorbent wool placed within the preputial orifice.

*Treatment of Complications.*—Inflamed chancres should be treated by keeping the patient at rest, on simple diet; and by the administration of a purge, and the application of lead and opium lotion or some other soothing dressing. In phimosis, if the swelling is so great as to prevent the use of the syringe, or if sloughing is threatened, the prepuce must be slit up or removed altogether, and the case treated according to the directions given for the treatment of phagedæna.

If in paraphimosis the prepuce be naturally too narrow, or if strangulation occur, reduction should be effected.

*Phagedæna.*—On the first appearance of signs of acute phagedæna, the affected part should be immersed for nine or ten hours a day in water, kept as nearly as possible at 98° Fahr. This can be easily accomplished by keeping the patient in a hip bath, and alternately adding and removing small quantities of water, so that the requisite temperature is maintained. Care must of course be taken to protect the patient from

cold, by placing the bath in a warm room, and by wrapping the exposed parts of the body in blankets. This plan has succeeded well at the Male Lock Hospital;[1] and if it be adopted at an early period the sore often becomes healthy in a few days; immersion, however, should always be continued for at least a day or two after this has occurred, to guard against relapse. The patient may generally be allowed to go to bed during the night, iodoform or some other suitable dressing being applied; but if the diseased action continue to extend, the duration of the bath must be prolonged, or even be made continuous; but in that case, as well as in those where the groin is the seat of the disease, a full-sized bath, in which the patient can lie down, will be necessary. In all cases the whole of the diseased surface must be fully exposed and thoroughly submerged.

If milder measures fail to arrest the phagedænic action, the sore may be cauterised. If the surface is large, the actual cautery will be more likely to succeed than chemical agents.

If cauterisation fail, as it sometimes does, or if it be thought unadvisable to have recourse to it, a lotion of tartarated iron (10 to 60 grains to the ounce) with extract of opium, is often of the greatest value.

Hæmorrhage from a phagedænic sore should always be checked as soon as possible. If the bleeding is slight the surface should be cleaned, and pellets of cotton wool, soaked in solution of persulphate of iron, pressed on each bleeding spot, and retained in position by a bandage applied as tightly as the patient can bear. In severe cases the actual cautery may be necessary, and in extreme instances ligature of the larger arterial trunks above the seat of disease may be required.

The general treatment of phagedæna consists in the administration of good food, tonics, and opium in sufficient quantity to relieve pain, though under the immersion plan of treatment pain usually quickly ceases, and little or no opium is required. Fresh air and good ventilation are also powerful aids to recovery.

The treatment of chronic phagedæna or serpiginous ulceration is similar to that of the acute form, but of course more time is allowed for the trial of palliative measures before having recourse to the cautery.

The treatment of simple bubo will be found under BUBO.

The management of the *virulent bubo*, after evacuation of the pus, differs in no respect from that of the local chancre, which has just been described; and the treatment here recommended for phagedæna applies equally to that morbid process, as a complication of the local chancre, of bubo, or of syphilitic ulcers, whether primary, secondary, or tertiary; but in this latter case the administration of mercury or iodine or both, according to circumstances, forms an important element in the management. In fact, in every case of obstinate phagedæna, especially of the chronic form, most careful search should be made for signs or a history of syphilis; for, if that taint be present, it not infrequently happens that all local applications fail until the constitutional malady is attacked.

ARTHUR COOPER.

[1] See *Lancet*, May 24, 1879.

**VENESECTION** (*vena*, a vein, and *secto*, I cut).—SYNON.: Bleeding; Blood-letting.—Abstraction of blood, by opening a vein. *See* BLOOD, Abstraction of.

**VENOM, Effects of: VENOMOUS ANIMALS.**—SYNON.: Fr. *Animaux vénéneux*; Ger. *Giftige Thiere.*

DEFINITION.—Animals which possess the power of secreting and ejecting a poison, which, when inoculated in man or other animals, produces toxic or even fatal effects.

Venomous animals are found in many classes of the animal kingdom.

**1. Reptilia.**—Reptilia furnish the most numerous and important examples of venomous animals, and these are limited almost entirely to the order *Ophidia* or snakes.

DESCRIPTION.—The poison-apparatus of a snake consists of a composite racemose gland, situated in the temporal region, secreting a clear, slightly viscid fluid, which is poured through a duct into a grooved fang situated on a movable maxillary bone.

The fangs are longer, more curved, more movable, and more formidable in viperine than in colubrine snakes.

Snake-poison is a clear, slightly viscid fluid, very deadly in its action, probably more active in some snakes, quantity for quantity, than in others, and varying in activity in the same species or individual, according to season, temperature, and state of health. It acts most rapidly when injected into the blood; but it can be absorbed through mucous and serous membranes, as seen by its poisonous effects when applied to the conjunctiva, the stomach, and the peritoneum. It may neither be applied to the lips nor taken into the stomach with impunity; and sucking a snake-bite is by no means free from danger, though if the saliva be quickly ejected and the mouth washed, the danger is probably small. It contains an active principle, which has been described as *echidnine*, *viperine*, and *crotaline*. Analysis has shown the poison to be very nearly like albumen in composition. It is most active in its action on warm-blooded creatures. It appears that poisonous snakes are very insensible to the venom of other poisonous snakes.

EFFECTS.—The action of the poison is *local* and *general*.

The *local* effects of snake-bite comprise pain; partial paralysis of the bitten part; ecchymosis; swelling; and if death does not rapidly follow, infiltration of other and distant parts, cellulitis, and sloughing.

Associated with these local effects are many severe *general* phenomena, such as depression, fainting, nausea, hurried respiration, vomiting, exhaustion, lethargy, loss of co-ordinating power, paralysis, loss of consciousness, hæmorrhagic discharges, relaxation of sphincters, coma, and convulsions. If the quantity of poison injected be small or its nature feeble, the earlier symptoms may give way, and recovery take place.

Snake-poison acts by paralysing the nerve-

centres—sometimes the peripheral distribution of the nerves, and by altering the constitution of the blood. It takes effect through the circulation; and if inserted into a large vessel, such as the jugular, humeral, or axillary veins, it will cause almost instant death, the heart's action stopping in systolic spasm. The respiratory centres, the spinal cord, the peripheral nerve-distribution, may all be affected; in ordinary cases death seems to take place by arrest of the respiration, the heart's action continuing for some time after apparent death. The muscular fibre itself would appear in some cases to have its contractility impaired or destroyed. The poison also acts septically, producing at a later period sloughing and hæmorrhage.

There are certain points of difference in the action of viperine and colubrine venom. In the former there is greater tendency to hæmorrhage than in the latter. Experiments on animals show that, generally, after death from cobra-poisoning the blood coagulates firmly, whilst after death from viper-poisoning the blood remains permanently fluid. In most cases of death in man the blood has been found fluid even after cobra-poisoning.

The convulsion or coma that precedes death is due to the circulation of venous blood in poisoning by colubrine snakes; probably to the direct action of the poison on the nerve-centres in poisoning by viperine snakes.

Prognosis.—In cases of moderate severity remedies, with careful nursing and tending, may prove successful; but where the bite has been thoroughly effected by the ophiophagus, cobra, daboia, echis, rattle-snake, craspedocephalus, cerastes, and others, the prognosis is very unfavourable; in no case, however, should efforts be relaxed until the last.

There is often uncertainty as to the kind of snake, its condition, and the extent to which its fangs were used. The great shock or depression which follows a snake-bite may be in a measure due to fright, and will, on reassurance, pass away. The marks of two well-defined punctures attest the insertion of two fangs, and, if the snake has not been seen, may enable one to form an opinion as to its character. Many of the innocuous snakes are fierce, and bite vigorously, but their numerous teeth leave different marks from those of the poison-fangs. There are exceptions to this rule, however; a few innocent snakes have the anterior maxillary teeth developed like poison-fangs, but bites from them are not very likely to occur.

It may be well to note some of the characters that distinguish the venomous snakes, as the form and arrangement of the teeth and an examination of the wound will reveal the true character of the bite, and serve to form a correct prognosis. On opening the mouth of a venomous colubrine snake, such as *naja* or *bungarus*, two well-developed fangs will be observed, one on either side; and close behind it there may be seen one or two smaller teeth. There is no row of teeth along the outer side of the mouth, but a double row will be found on the palatine surface. In the viperine and crotaline snakes, a large fang will be found on either side, and a double palatine row. There are no small fixed teeth behind the fangs as in colubrines, but in a fold of mucous membrane at the base of the fangs, both in vipers and colubrines, a set of loose reserve fangs will be found. In *hydrophidæ* the fangs are arranged like those of the cobra, but are very minute, and no reliance can be placed on any mark made by them. The circumstances under which a bite is inflicted will generally help to indicate the kind of snake.

Harmless snakes have a double row of equal or nearly equal-sized teeth in the maxillary and palatine bones. But, as before stated, there are certain innocent snakes that have long anterior maxillary teeth, which might cause doubt as to the nature of the bite.

Treatment.—There is reason to believe that the numerous agents that have been recommended from the earliest times as antidotes of snake-poison are useless, and have no such properties as those ascribed to them.

The rational treatment of snake-poisoning is to endeavour to prevent the entry of the virus into the circulation; to neutralize it in the wound before it is absorbed; to support the failing nervous force if it have entered; and to favour its elimination.

The application of a ligature applied tightly between the bite and the heart, and the immediate excision or destruction by cautery or caustic of the bitten spot, are essential; and other local measures subsequently may appear necessary. The injection or the application to the puncture of some decomposing agent, such as liquor potassæ or permanganate of potash, has been especially recommended in Australia, in Brazil, and in India.

The constitutional treatment requires that the strength should be supported by stimulants, such as alcohol and ammonia. Next, if the respiration be failing, artificial respiration should be resorted to. Elimination should be promoted by stimulating diuretics. The patient should be kept warm; and must not exhaust himself by walking about. Ammonia has always held a high place among remedies in snake-poisoning; and its injection into the veins has been warmly advocated in Australia, and seems to have met with success there which it had not in India.

The statement that no *lizard* is poisonous, is not strictly correct. The heloderm (*heloderma horridum*), of Mexico, possesses venomous properties, destructive to small animals, and injurious to man himself.

2. **Amphibia.**—None of the amphibia are known to possess a poison-apparatus like that of ophidia; but toads and salamanders secrete a fluid in glands along the back, connected with the integument, which yields an actively venomous principle, capable of causing local irritation, and when injected into the blood, death, preceded by symptoms indicating action on the cerebro-spinal nerve-centres. Dogs seizing the toad, *Bufo vulgaris*, are known to suffer from swelling of the lips and salivation; and a case of death was related in France, in 1865, of a child in whom an abrasion of the hand came in contact with the secretion of a toad; death was preceded by vertigo, vomiting, and fainting. When this poison is injected into guinea-pigs, small birds, and other animals, violent symptoms and

death soon follow. It is a viscid, milky fluid, with a slight yellow tint and peculiar odour; it is exuded, and may be pressed, from glands behind the orbits. Zalesky has shown that the land and water salamanders, *S. maculatus* and *Triton cristatus*, and probably others, have also the power of secreting venom; and his experiments prove that it contains a very active principle—salamandrine, and that its action on the cerebro-spinal nerve-centres is energetic. It appears that these poisons, like those of ophidia, though effective on others, have no action on their own species.

3. **Pisces.**—DESCRIPTION.—Several fishes are provided with an apparatus consisting of a cavity at the base of, or a sac and duct leading to, a channelled spine, through which an irritating secretion is ejected. No true poison-gland, however, has as yet been certainly made out. This secretion is apparently connected with the secreting mucous system; and in certain species it produces marked symptoms of poisoning, though never to the same extent as in the case of the poison of venomous snakes. Fish armed with sharp or serrated opercular or fin spines can inflict severe and painful injuries, liable to cause great pain, and to be followed by the grave symptoms attributable to the lacerated or punctured nature of the wounds; and these may be aggravated by the irritating nature of the mucus with which they are contaminated. In several, however, in addition to the spine, there is a distinct receptacle in connection with it, either in the form of a sac or duct such as in the *thalassophryne*, or in a cavity in the spine itself, as in the *trachinus* or weever.

In the case of others, such as the sting-rays, which may produce severe wounds by their pointed and serrated spines, there is no distinct receptacle for the poisons in connection with them. Whilst it is well known that many spiny fish are capable of inflicting wounds that are dangerous from their lacerated and punctured character, it is recognised that others increase the danger by the inoculation of an irritating fluid, as stated above.

EFFECTS.—The effect of fish-poison is to produce severe burning pain at and beyond the injured part, and fever. The intensity, no doubt, depends upon the quantity of poison injected, and the state of health and constitution of the person at the time. The wound alone, even without the poison, is likely to be painful and severe from its punctured character.

TREATMENT.—Ipecacuanha, alkalies, alum, and ammonia have all been recommended as useful external applications to allay the irritating action of such poisons. Poultices of onions, or warm applications of opium or other sedative fomentations, are likely to be useful; and prompt surgical relief, if suppuration or cellulitis occurs, is necessary to relieve tension, to evacuate pus, or give exit to sloughs.

The constitutional treatment is such as would be indicated by the condition and progress of any other inflamed punctured wound. In case of depression of the heart's action, alcohol or ammonia would be indicated. Rest, quiet, and due attention to the state of the bowels and of elimination by the skin and kidneys, with careful regulation of the diet, should be observed. *See* POST-MORTEM WOUNDS.

4. **Mollusca.**—*Aplysia punctata*, the sea-hare, a gasteropod, is said by some to produce an irritating secretion capable of causing urtication and even severe inflammation, and of causing the hair to fall off.

5. **Arthropoda; Myriapoda**, family *Scolopendridæ*.—The centipedes possess mandibles, formed by a pair of dilated feet, joined at their origin, with perforated, hook-like points with an aperture near the apex, through which a poisonous fluid, secreted in a poison-gland, sac, and duct, is ejected when they bite, which they can severely. This, in the case of the larger tropical species, is sometimes very painful, and causes considerable local irritation, and even constitutional disturbance, fever, and delirium. That of the smaller kind generally causes only local and transient irritation. Centipedes are found all over the world nearly, in Europe, Africa, America, the East and West Indies and Islands, and in the tropics generally. Those of warm climates are the largest and most dangerous.

6. **Arachnoidea.**—*Scorpionidæ* or *Pedipalps*. DESCRIPTION.—Scorpions have a segmented abdomen, the last six joints of which are narrowed into a tail, terminated by a curved perforated spine or hook, with which they strike and wound. At its extremity are two small orifices, through which venom is injected from a gland-receptacle and duct at its base. Scorpions run about quickly, carrying the tail curved over the body. They live in holes in the ground, and under stones or logs of wood, in dark places. The tail is used as an offensive weapon. They seize small creatures with their palpi, and then pierce them with the sting. The venom is so active that it quickly destroys life. Those of tropical climates are most active and poisonous. They attain to the length of from two to three, four, and six inches. The European genera are smaller and less active.

Scorpions exist in all tropical countries, but extend also into the warmer regions beyond the tropics. They are found in the East and West Indies, Ceylon, and other islands, Australia, Africa, Egypt, South of Europe, and America. There are several genera, and *Buthus afer*, *Androctonus*, and *Buthus Cæsar*, are good examples of the active kinds. *Europæus* and *Occitanus* are also venomous, but those of Europe are less active than the tropical forms.

EFFECTS.—The effects of the sting of the scorpion and of the bite of the centipede have no doubt been exaggerated; but they may produce very painful, and in the case of the larger species, severe and serious symptoms, in their character not unlike, or even more severe than, those of the sting of the wasp, namely, pain, swelling, in some cases numbness, vertigo, nausea, vomiting, temporary loss of vision, swelling of the tongue, and fever. Death may occur in delicate or sickly subjects. The local and constitutional symptoms may be severe in persons of irritable constitution, or otherwise out of health, but generally in the case of bites of ordinary scorpions or centipedes inflicted on healthy subjects, the suffering is local and soon passes away.

TREATMENT.—A variety of remedies have

been recommended for scorpion-poisoning. Probably the application of a ligature above the bitten part, or a cupping-glass, or suction of the wound, as in snake-bite, might be useful. Some authorities recommend that the wound should be scarified, volatile ointment rubbed in, and an emollient poultice applied. Suction of the wound, and the application of salt water, vinegar, ammonia, alum, ipecacuanha, spirits of camphor, eau de Cologne, tobacco water, turpentine, tincture of iodine, alcohol, the leaves of cruciferous plants made into poultices, solutions of opium and lead, or other sedatives, all seem to lessen pain and irritation. The use of diffusible stimulants, opiates, or other sedatives may be necessary, and such surgical interference as suppuration or cellulitis may require.

7. **Arachnida.**—DESCRIPTION.—Some spiders are venomous, and certain of the larger tropical forms are capable of inflicting painful bites. The poison-apparatus of spiders consist of falces or modified mandibles or jaws, the last joint of which is a hard curved fang, with a fissure near the point; there is an elongated poison-sac and duct in which the venom is elaborated and thence transmitted to the fang, by which it is inoculated into the flesh of its prey.

EFFECTS.—The venom of spiders is a very active principle, and apparently is capable of rapidly destroying the life of the small creatures on which the spider feeds. It also causes symptoms of poisoning in man and the lower animals. Probably all the species have some venomous secretion, but it is only the larger kinds that are obnoxious to man. It may be noted that whilst the fangs of one section of spiders move laterally, those of the Mygalidæ move vertically.

There are several species. Those reputed venomous are tropical.

*Lycosa tarantula* is reputed to cause extraordinary symptoms. It is poisonous, but there is no reason to believe that its effects exceed a certain amount of local irritation. *See* TARANTISM.

There are numerous families, genera, and species of spiders, all probably possessing an irritating fluid; but it is only in the larger kinds that they do so to any extent, and there is no very positive proof that even in tropical climates they inflict the grievous injuries ascribed to them, though the venom is very fatal to the creatures on which they prey.

The popular notions that the spider is very poisonous when swallowed, and that its web possesses medicinal properties, are probably exaggerated, if not altogether untrue. One species of red spider, however—perhaps a mite—called *coya*, in Popayan, is very poisonous; the juices of its body when crushed, and coming in contact with the punctured skin, cause tumours, or even it is said death. This is no doubt an exaggeration, but it is probable that the juices are acrid and irritating, and it is therefore better not to crush them when detected on the person, but to brush or blow them away.

In India, a streak of almost erysipelatous redness of the skin coming on rapidly, is often attributed to a spider. No one has defined the species; it is possible that it may be analogous to that just referred to.

TREATMENT.—The treatment of spider-bites is similar to that of centipedes and scorpions.

8. **Acarina.**—DESCRIPTION AND EFFECTS.—Some mites have the power of causing considerable irritation by a secretion ejected on the surface, or injected into the wounds they make in their burrowing operations with claws or mouth.

The *Tetranychus autumnalis*, *Leptus autumnalis*, or Harvest Bug, is brick-red in colour, and very minute. It is bred on plants, but leaves them to fasten on animals, especially man, when it adheres firmly, and causes swelling, great irritation, and severe itching, if in numbers. The intense irritation causes fever. The symptoms are not unlike the sting of a nettle, erythema or even blistering being caused. The leptus is covered with hairs, and effects entrance into the skin with its claws, and thus gives rise to the great irritation, which is probably aggravated by some acrid excretion. These animals are found in Britain, France, and other parts of Europe; varieties of them in the tropics, for example in Brazil, Honduras, on the Mosquito Coast, and in the West Indies. The *T. irritans* of the Mississippi valleys causes great irritation in the same way.

TREATMENT.—The treatment is to extract the bug with a needle or the point of a knife, and then apply some soothing lotion.

*Argas persicus*, a gamosid, known also as the *Teigne de Miana*, venomous bug of Miana, is common in Persia. It is found in the houses, and it is said that its puncture produces serious symptoms, such as convulsions, delirium, and gangrene, or even death. This is an exaggeration, though probably it is true that local irritation, and perhaps some constitutional disturbance, may be caused. It is blood-red in colour, spotted with white on the back, the feet yellow. *Argas moubata*, a native of Angola, is said to have much the same properties.

The *Argas talaje* of Guatemala produces great irritation. It bites like an ordinary bug, and the punctures are followed by great irritation, swelling, and pain. It lives in holes in the bamboo walls, or such-like crevices, and issues at night to attack the sleepers.

9. **Hemiptera.**—Some of the *Geocorysæ* and *Hydrocorysæ*, or land and water bugs, have irritating properties, and also an offensive odour; they have a suctorial mouth, armed with a grooved instrument or rostrum for piercing the skin.

*Cimex lectularius*, the bed bug, causes much irritation, and in some persons inflammatory action in the bitten part. The effects are transient

*Notonecta* and *Nepa*, common in pools of water in our islands, are also capable of inflicting a painful puncture. *Cimex nemorum* causes nearly as much pain by its puncture as the sting of a wasp. The wheel bug, *Reduvius serratus*, of the West Indies, gives an electric shock to the person it touches. St. Pierre mentions a species of bug in the Mauritius whose bite is as venomous as the sting of a scorpion. The *Benchucha*, or great black bug, of the pampas of South America, is more obnoxious, it is said, than the common bed bug.

10. **Aphaniptera.**—*Pulicidæ* or Fleas comprise several families. *Pulex irritans*, the com-

mon flea, is universal. It varies much in size and colour; some are almost black and very large, and are found on the sandy shores of the Mediterranean. There are many species, such as *P. canis*, *P. musculus*, *P. vespertitinus*, and others. *Pulex penetrans* of the West Indies and South America, known also as the jigger or chigoe, penetrates the skin, and beneath the nails, generally of the feet, causing great irritation. It will, if not extracted, deposit its ova, and thus give rise to severe irritation. The effects of the ordinary flea-bite are well known. Though the irritation of flea-bites is chiefly due to the wound, there is reason to believe that this is aggravated by the presence of some irritating secretion. No special treatment need be described.

11. **Diptera.**—Description and Effects.—To this order belong the gnats, mosquitoes, pipsas, sand-flies, and gad-flies, all more or less dreaded for their bites. They have a proboscis composed of a grooved and flexible sheath, through which long, slender, sharp darts are protruded, that pierce the skin and inoculate some venomous secretion, though its nature is not known. They draw blood, raise white lumps or swellings; some, such as the pipsa of the Cossiah Hills, India, leave a livid spot of effused blood, which gives to the sufferer the appearance of a purpureal rash. They swarm in many countries, generally near water. The principal forms are the *Culex pipiens*, *C. reptans*, *C. mosquito*, *C. laniger*, and the whame fly, *C. tabanus*. Some of these are formidable insects, and are insatiable blood-suckers. The *tsetze* or *tzmb*, *Glossina morsitans* of Africa, is one of the most remarkable. The bite of this poisonous insect is almost certain death to the horse, ox, or dog; though it appears not to trouble man more than by causing slight irritation.

The female *Simulium*, or sand-fly, is irritating to man, the bite often giving rise to painful swellings. The pipsa is probably a simulium. It appears from the great irritation and the swelling that follows the puncture of most of these insects, that some acrid secretion is injected into the wound. In young full-blooded persons, especially recent arrivals in India or the tropics, the irritation caused by mosquito-bites is often so severe as to give rise to violent inflammatory symptoms, resulting in suppuration or ulceration, and even gangrene.

Treatment.—The application of common salt, solution of ammonia, soda, potash, lead, oil, ipecacuanha, or alum combined with opium, allays irritation in the first stage. The more violent inflammatory symptoms are amenable to ordinary surgical treatment. Camphor, pulegium, and lime-juice, applied to the skin, are all regarded as preventives.

12. **Hymenoptera.** — Description and Effects.—A number of species that secrete poison are found among the different families of hymenoptera, including bees, wasps, and ants. *See also* Sting.

They are distinguished by the presence of an ovipositor in the female, which not only is used for depositing the eggs, but as a weapon for injecting venom. It consists of two valves as a sheath, and three bristles which form a grooved sting. Through this groove the poison is injected into the wound, the ovipositor being connected with a poison-gland at its base.

*Formicidæ.*—Ants include *Formica smaragdina* and many others. The sting of the ant causes considerable irritation, especially if many. It has been suggested that formic acid is the irritating principle. There are several venomous species of ants, black and red, of various sizes. Some of the larger forms in the tropics are capable of inflicting a very painful injury. Some ants have no sting, but eject a fluid which irritates the skin.

*Vespidæ.*— The females and workers of the wasps and hornets are provided with a poison-sac and sting. *Vespa vulgaris* is a type of the tribe *Crabro*. It lives in communities. Its sting produces much irritation, pain, and swelling, especially when inflicted on the face, or where the cellular tissue is loose.

*Apidæ.*—True bees, and the *Bombidæ* or humble bees, have similar properties, their sting producing very much the same effect as that of the wasp.

Some of the parasitic *Hymenoptera* inject a poison into the wound made by their ovipositor. The best known instance is that of the genus *Ophion*. The genus *Paripla* also injects a poison in the same way, and probably others of the *Ichneumonidæ*.

Treatment.—Many remedies of a simple nature have been recommended to allay the pain and irritation caused by the sting of the wasp and bee, such as vinegar, eau de Luce, ammonia, solution of soda or potash, oil, indigo, eau de Cologne, alum, and all those recommended in scorpion-stings. In case of venomous stings, where constitutional disturbance is induced, stimulants or sedatives may be necessary; and as the sting is liable to be left in the wound, it ought to be picked out. In cases of wasp or bee stings in the mouth or throat, which may happen when children bite a peach or other fruit that conceals a wasp, severe consequences may arise from the œdema that supervenes, and extends to the glottis. An emetic is then useful. With the ordinary treatment of œdema, laryngotomy may become necessary. In other cases, should violent symptoms supervene, surgical aid may be required to relieve tension, or give exit to matter. Such untoward results, however, are happily rare.

*Mutilla coccinea*, a native of the warmer parts of North America, is said to produce loss of consciousness within five minutes of the infliction of its sting, life being in danger for some days afterwards.

13. **Lepidoptera.**—The majority of insects furnished with a sting, as a means of defence, belong to the Hymenoptera. It is but recently that a stinging Lepidopterous insect has been found. The species is not mentioned (F. Smith). The bee moth of the Cape of Good Hope is said to defend itself with a sting. Though the majority of the perfect insects of this tribe are harmless, some of the caterpillars appear to be possessed of irritating properties, residing in the fine hairs with which they are cased, and which, being sharp and brittle, break off and remain in the skin, causing irritation mechanically; but also probably from the presence of some acrid

substance concealed within the hairs. In Ceylon, a greenish hairy caterpillar, longitudinally striped, probably of the genus *Bombyx*, which frequents the leaves of *Hibiscus populneus*, alighting on the skin, causes as much irritation as the sting of a nettle. The larva of *Neæra lepida*, has similar properties. It is short and broad, of a pale green, with fleshy spines on the upper surface, each of which is charged with venom that occasions acute suffering. The larvæ of *Adolia* are also armed with venomous hairs. Another, not uncommon in certain trees in the terai of the Himalaya, is a dark-coloured hairy caterpillar, which is apt to fall on people and cause intense irritation. It is known as the *Komlah*, but the moth that produces it is not known.

14. **Coleoptera.**—Several beetles have acrid secretions capable of exciting great irritation and inflammation, raising blisters, and if absorbed causing painful strangury and great urinary irritation. Such are *Mylabris Cichorii* of India, *Cantharis* or *Lytta*, or *Meloe vesicatoria*, *Lytta gigas* of Senegal, *Lytta vitata* of America, and *Lytta ruficeps* of Chili.

15. **Echinodermata.**—The long sharp pointed spines of some of the echinids are capable of inflicting painful punctured wounds, but convey no true venom. Whether, as in the case of some spiny fishes, there may be an irritating mucous secretion inoculated is uncertain.

16. **Cœlenterata.**—Some of the *Medusæ* or jelly-fish have the power of stinging. The poison-apparatus is placed in certain tubercles on the surface. These contain a collection of granules, amongst which are small vesicles. Within these corpuscles or nematocysts a spiral thread is found, which bursts out on pressure. These corpuscles are found in the mucus exuded by the creature, and to them is attributed the urticating power it possesses. There are several stinging species, some found on our own coasts, others in other seas. It is the larger forms generally that are venomous, the small ones having no effect on man. *Cyanea capillata* of our seas is a most formidable creature, and the terror of bathers. It has a broad tawny disk, and a long train of ribbon-like streamers floating after it; it makes its way through the waters; and whatever comes in contact with these trailing trains soon writhes in torture, the effect produced being not unlike that of the nettle.

*Physalea pelagica*, the Portuguese man-of-war, has similar properties. It causes severe and stinging pain, extending up the limb, with feverishness, which has been known to continue for some hours, white wheals forming on the skin, as in urticaria. Several other medusæ possess these properties, and hence they have received the name of Acalephæ, or sea-nettles. The application of vinegar or olive oil is said to remove the unpleasant symptoms.

The *Actiniæ*, or sea-anemones, and the hydroid polyps, appear to possess a similar power, and are provided also with thread-cells. They cause urtication of the human skin when brought in contact with their tentacles. The *Sagartiadæ* furnish examples of sea-anemones with this property. The effects, however, of any of them are transient. In some parts of Europe the *Acalephæ* have been used therapeutically as counter-irritants, by being brought in contact with the patient immersed in a salt-water bath.

In the preceding description the writer has not attempted to treat exhaustively the subject of venomous animals, or to describe all the forms of animal life so endowed. His object has been to point out the principal forms, and to indicate generally the mode of dealing therapeutically with the effects of the venom.

JOSEPH FAYRER.

**VENOUS HUM.**—A peculiar murmur heard on auscultation of the larger veins, especially those of the neck and chest, in anæmia, and in cases of interference with the flow of the blood through those vessels. *See* PHYSICAL EXAMINATION.

**VENTNOR, in the Isle of Wight.**—A mild, dry, bracing climate. Mean winter temperature for forty years, 42·43° Fahr. Exposed to S.S.E. and S.W. winds. *See* CLIMATE, Treatment of Disease by.

**VENTRICLES OF THE BRAIN, Diseases of.**—SYNON.: *Maladies des Ventricules du Cerveau*; Ger. *Krankheiten der Gehirnhöhlen.*—The chief morbid states of the ventricles of the brain are (1) *new growths*, *degenerations*, and *inflammatory changes* in the **lining membrane** (ependyma) and **velum interpositum**; and (2) accumulations of *blood*, *pus*, and *serum* in the **ventricular cavity.**

1. **Diseases of the lining membrane and velum.**—In old age, and in degenerative brain-diseases, such as general paralysis, the ependyma of the ventricles becomes *thickened.* The surface is uniform, or, in some cases, covered by minute warty granulations. Some of the latter may attain the size of a pea, and constitute small fibrous tumours. Similar changes are sometimes found when the brain has been subjected for a long time to passive congestion. In rare cases the thickened membrane has been found *calcified* in places. A few *morbid growths* have been met with in the ependyma, the most common being the granulations of tuberculosis, which have been found both on the lining membrane and the choroid plexus. The latter and the velum interpositum frequently present thickening, and undue adhesion to the ependyma. In rare cases *fatty growth* has been met with in this situation. The choroid plexus may present partial *fatty degeneration*, and frequently contains *corpora amylacea.* Aggregations of *brain-sand* are common in the choroid plexus, and occasionally occur in the lining membrane.

*Cystic degeneration* is the most common morbid appearance in the choroid plexus, especially in that part which is within the descending cornu. The cysts are clear, delicate, colourless, transparent, from the size of a pea downwards. They consist of delicate cells pressed together, which are simply normal cellular elements of the part that have undergone a peculiar degeneration. In some of the larger ones these cells have become destroyed in the centre, so that a true fluid-containing cyst remains.

The adhesions sometimes met with may cut

off the posterior cornu from the rest of the ventricle, and it may thus be obliterated.

The ventricles may undergo passive *congestion* in common with the intracranial organs, or from pressure upon the veins of Galen, which return the blood from the velum interpositum. In the latter case considerable effusion of fluid may occur.

*Inflammation* involves both the ependyma and the velum interpositum. It is rarely confined to the ventricles, still more rarely to one. Commonly it is part of a general meningitis. The ependyma and the velum are thickened and pulpy, being infiltrated with cells of new formation. The velum is always injected; the ependyma may be injected or pale. Occasionally a false membrane is found upon its surface. The tissue of the brain beneath the ependyma is softened, and may be injected. The fluid in the ventricles is increased in quantity, and is turbid from pus and exudation-cells, and even *débris* of nerve-fibres. The inflammation, of which this is part, is usually fatal; but it may pass away, the ependyma and velum remaining thickened and adherent. *See* MENINGES, CEREBRAL, Inflammation of, Tubercular.

2. **Intraventricular accumulations.**—*Hæmorrhage* rarely occurs directly into the ventricles, except by traumatic rupture of a vein; but blood may reach them from within the cerebral substance, or from the subarachnoid space. True *pus* may be found in the cavities, from the bursting into them of a cerebral abscess; and a purulent fluid may result from inflammation of the lining membrane. A slight effusion of *serum* results from inflammation, but is rarely considerable, unless the escape of that secreted by the choroid plexus is prevented by the closure of the passage to the fourth ventricle from external pressure, or by the obliteration of the foramina in the membrane closing in the fourth ventricle, by which its cavity communicates with the subarachnoid space (Hilton). *See* HYDROCEPHALUS. In atrophy of the brain, the fluid within the ventricles (as beneath the arachnoid) undergoes a considerable compensatory increase.

Lastly, by violent commotions of the brain the septum lucidum may be *ruptured* (Wilks and Moxon).

*Ventricular hæmorrhage* and *hydrocephalus* are described in other parts of this work. *See* BRAIN, Hæmorrhage into; and HYDROCEPHALUS.

The other conditions discussed are marked by no distinctive symptoms, and call for no special treatment.

W. R. GOWERS.

**VENTRICLES OF THE HEART, Diseases of.** *See* HEART, Diseases of.

**VERDIGRIS Poisoning by.** *See* COPPER, Poisoning by.

**VERMES** (Lat. worms).—This is a term of variable import, according to the practical or scientific stand-point from which it happens to be viewed. Thus Gegenbaur includes in this group, not only the helminths or entozoa and their allies, but also a multitude of creatures of widely differing structure, as well as the annulated animals properly so-called (*Grundzüge der Vergleich. Anatomie*, 1870, s. 155 *et seq.*). The late Professor Rolleston, in like manner, elevates the term so as to make it of *sub-kingdom* value in zoology. Practically, the term 'Vermes' is used as the equivalent of *Entozoa*, which latter term, as we have explained elsewhere, has a wider signification than its simple literal meaning implies. *See* ENTOZOA; HELMINTHES; INTESTINAL WORMS; PARASITES; and WORMS.

T. S. COBBOLD.

**VERMICIDES** (*vermis*, a worm, and *cædo*, I kill).—A group of anthelmintics which kill worms. *See* ANTHELMINTICS.

**VERMIFUGES** (*vermis*, a worm, and *fugo*, I expel).—A group of anthelmintics which expel worms, but do not necessarily kill them. *See* ANTHELMINTICS.

**VERRUCA** (Lat. A wart.)—SYNON.: Fr. *Verrue*; Ger. *Warze*.

DEFINITION.—A wart or papillary growth from the skin.

ÆTIOLOGY.—The wart, being an aberration of growth of certain of the constituents of the skin, must necessarily result from a want of normal power within the integument; hence it is mostly found in children and elderly persons, and is less frequently met with in the adult. As children become developed by growth, and their tissues acquire strength, these partial exuberant growths disappear. In young persons of feeble organisation they are sometimes thrown out like an exanthem, and yield to a constitutional treatment directed towards the improved innervation and nutrition of the tissues. Their direct relation with the nervous system is often evinced by their sudden disappearance under the influence of mental emotion, a circumstance which has led to the popular use of charms for their cure. In elderly persons they are often met with on the face, where their presence must be ascribed to debility of integument; and they are frequently associated with dirt and neglect. Briefly, warts may be said to be due to aberration of nutritive function of the skin, consequent on defective organisation and vitality.

DESCRIPTION.—Pathologically a wart is an hypertrophy or excessive growth of a small group of papillæ of the skin, with excessive production of cuticle, forming a hard prominence of the integument. Warts vary in size, and are modified according to situation. They sometimes cover a considerable extent of surface in patches several inches in diameter, but more commonly appear as tubercles, either few in number and isolated, or numerous and in clusters. One kind is remarkable for the minimum of prominence, resembling a flat, dirty-looking blotch on the skin; whilst another, as on the hands, may have a prominence of a quarter of an inch, or on the scalp of half an inch.

Warts on the hands afford the commonest illustration of verruca, as in this situation, from the greater nutritive energy of the skin and the abundance of epidermis, they are most frequent and most highly developed. When of recent growth they are convex and smooth on the surface, but when of longer standing the apex is flat, from the wearing away of the superficial cuticle, and the anatomy of the wart becomes dis-

closed. Then it is apparent that the wart is composed of a bundle of fibres, held together in a cylindrical form by a boundary of thickened cuticle. Each of these fibres is a vascular papilla of the skin, enclosed in a sheath of cuticle, and the collective mass forms the body of the growth. An old wart will frequently split up into several segments—*V. lobosa* or lobulated wart, and then its construction of fibres—*V. fibrosa*, is strikingly conspicuous. If a wart be cut through horizontally, the vascular papillæ will be cut across, and then the structure of a wart of papillæ and horny sheaths is still more evident. On the fingers, and especially the knuckles of children, the verruca is isolated and large, and not unfrequently confluent, and on the back of the hands and wrists, as also on the forehead, it is often developed in crops, like an eruption; but these latter never attain the dimensions of the isolated warts of the fingers.

Verrucæ are generally sessile—*V. sessilis*; but on the scalp they are frequently pedunculate, and, from a peculiarity of structure, have been denominated digitate—*V. digitata*. The digitate character of the warts of the scalp is due to the lesser quantity of epidermis occurring in that region; consequently the hypertrophous papillæ are not held together by a ring of thickened cuticle as elsewhere, but being left to themselves shoot out from the centre like fingers; the papillæ likewise grow to a greater length, and their cylinder is swollen so that the bulk of the mass greatly exceeds that of the base from which they spring. Nevertheless, the digitate verruca must be distinguished from *V. acrochordon*, and the cauliflower-shaped venereal warts, both of which are growths of the integument, and are not restricted to the papillæ cutis alone; and thereby fall into the category of molluscum, with which, especially acrochordon, they are closely allied in pathological structure.

The normal colour of warts on the hands is a yellowish-grey, but from their roughness they are apt to retain dirt in their crevices, which gives them a brownish appearance. The flat warts of the trunk of the body and face are accompanied with the production of pigment, and their dirty colour is consequently more striking. A number of warts congregated on the skin suggested to the fathers of medicine the idea of ants crawling over the body, and this appearance they designated *myrmecia*; whilst, another resemblance, which can be frequently verified, brought to the mind the blossom of the thyme, hence the term *Thymion* employed by Hippocrates.

Diagnosis.—As a simple epidermic growth enclosing hypertrophous papillæ, verruca is very distinct from other affections of the skin attended with hypertrophous growth of cuticle. The lepra of Willan is accompanied with hypertrophous papillæ and cuticle, but the latter is a morbid product, and is spread out in the form of laminated scales. Ichthyosis likewise is a combination of hypertrophous papillæ, enclosed in epidermic sheaths, with accumulation of cuticle, but is apt to be associated with filiform and branched processes of the actual integument.

True idiopathic warts must be distinguished from other diseases which sometimes put on a warty appearance, especially *carcinoma* and *syphilis*. *Epithelioma* of the skin is occasionally seen as a circumscribed warty growth, but generally with adherent scabs covering superficial ulceration. These signs, together with infiltration of adjacent tissues, implication of neighbouring glands, and pain, would arouse suspicion. It must be remembered, however, that epithelioma frequently attacks a simple wart which has remained quite passive during a lifetime; rapid increase of growth with the above-mentioned symptoms would suggest the supervention of epithelioma.

Any chronic inflammatory process of the skin, especially *syphilis*, is liable to take on a papillary character. Without referring to the papillary growths of early syphilis (condylomata), which could scarcely be confounded with simple warts, on account of their position and moisture, mention may be made of the dry warty character assumed by old syphilitic lesions, especially such as have been preceded by ulceration. The history of the disease (previous ulceration, &c.), together with other concomitant symptoms of syphilis, would assist the diagnosis.

As of venereal origin, though never syphilitic, *ordinary* 'venereal warts' must also be noted. Other names by which they have been described suggest their characters, such as 'pointed condyloma,' and 'cauliflower excrescence.' They are generally bright red in colour; and the individual papillæ are pointed. The rapidity of their growth, and the situation where they usually occur (the genitals), serve to distinguish them from verrucæ. Moreover they most often accompany gonorrhœa, being caused by the irritating discharge.

Prognosis.—Verruca is a blemish rather than a disease, and unimportant in its relations to the general health. By an error of diagnosis we sometimes read of malignant warts, and warts have been confounded with those fleshy growths termed 'tegumentary nævi.' Moreover in elderly persons a warty state of the skin is sometimes associated with asthenic ulceration, and occasionally with rodent ulcer, for which the depraved state of the skin, and not the wart, is responsible.

Treatment.—The best method of treating verrucæ is to touch them with some solvent agent, such as acetic acid. This acid dissolves the epidermis, and reaching the vascular papillæ, destroys the whole structure of the wart down to its root. The pulpy mass then dries up into a scab; and when the scab falls off, the growth rarely reappears. This little operation may either be completed at one sitting, or it may be repeated daily until its purpose is effected. Where there are numerous verrucæ to be dealt with, the process is tedious, and is generally left in the hands of the patient. The writer prefers a saturated solution of potassa fusa, carefully applied by means of a minute pencil of sponge fastened to the end of a stick. The alkali acts more speedily than the acetic acid, and effects a more thorough cautery of the vascular plexus, from which the hypertrophous papillæ derive their capillary loops. The verrucæ digitatæ of the scalp are speedily and easily removed by this process. In the exanthematous form the

verrucæ are too small and too numerous for the caustic application. These may be treated by frictions of sulphur ointment or tar ointment; and in this latter form the verrucæ are frequently entirely removed by a course of treatment with liquor arsenicalis, in three- or four-minim doses, taken immediately after meals, three times a day. ERASMUS WILSON.

**VERTIGO** (*verto*, I turn).—SYNON.: Giddiness; Dizziness; Swimming of the head; Fr. *Vertige*; Ger. *Schwindel.*

DEFINITION.—The consciousness of disordered equilibration.

PHYSIOLOGICAL RELATIONS.—To understand vertigo normal equilibration must be briefly considered. The equipoise is maintained by a sensori-motor mechanism. The coördinating centre is the cerebellum; the afferent or sensory apparatus consists of visual, tactile, and labyrinthine impressions; the efferent or motor apparatus are the muscles, chiefly those of the head, neck, and spine. Derangement of any part of this mechanism may lead to vertigo, by interruption of its power of adjustment. Vertigo is often associated with reeling or staggering, and is incorrectly said to cause it. Actually vertigo is the consciousness of disturbed locomotor coördination—a rudimentary disorder of coördination of locomotive movements (Hughlings Jackson), whilst reeling is an adaptive effort to preserve the equilibrium. A fact that supports the assertion that vertigo is a rudimentary disorder of coördination, is that when in a person, who has a sensation as if he were moving or turning in a certain direction, movements actually take place, they are always in the direction in which he previously felt he was turning when no outward movements occurred. Experimental researches and observations in disease have established the conclusion that the semicircular canals take an important share in normal equilibration; injury and disease of these parts occasioning locomotive incoördination, temporary when one side only is deranged, permanent when both sides are involved. The arrangement of the semicircular canals, and the physical principles involved in their actions, are very complicated, but have been carefully studied and explained by Flourens, Cyon, Crum-Brown and others; and it has been demonstrated by Flourens that injury of each canal is followed by definite locomotive disturbance, causing the body to tend to fall, or actually to fall, in a definite and precise direction, forwards, backwards, or to one or other side, according to which of them is injured. The sensory impressions originating in the semicircular canals are caused by varying tension of the endolymph, communicated to the vestibular division of the auditory nerve spread out on the ampullæ of the membranous canal. Variations in labyrinthine tension may be produced by alterations in the position of the head, by differences in the vascular tension of the labyrinthine blood-vessels, and by the varying pressure in the middle chamber of the ear, induced by obstruction of the Eustachian tube, spasm of the tensor tympani muscle, and other causes; and it may also be due to disease of the labyrinth itself, or communicated to the labyrinth. Visual and tactile impressions are liable to be deranged in many ways, for instance, by unexpected or unusual movements, as in swinging, being at sea, &c.; by local disease of the visual and tactile apparatus; and by disease in the nerve-trunks and spinal cord, interrupting conduction from the periphery to the centre. By disturbances in visual, tactile, or labyrinthine impressions the equilibrising centre is uninformed or misinformed, and incoördination results, outwardly shown by reeling or falling, and inwardly by the sensation we call vertigo. Loss or perversion of visual or tactile sensations may be compensated for, if the two remaining sensory processes continue intact, but nothing compensates for entire loss of labyrinthine impressions (Ferrier). The vestibular nerve which is distributed to the semi-circular canals is a branch of the auditory, the nucleus of which in the medulla is in close relation with that of the vagus; and thus the fact is explained that disturbances in the large area of distribution of the pneumogastric are found associated with labyrinthine disease, by propagation of the irritation from the nucleus of the auditory to that of the adjacent vagus; and conversely the intimate association of these two nuclei enables us to understand how disease of the stomach and other viscera occasions vertigo. It must further be borne in mind that the labyrinth receives its blood-supply from the vertebral artery, which at its origin from the subclavian is in near propinquity to the inferior cervical ganglion of the sympathetic, from which it receives a rich plexus of nervous filaments. The inferior cervical ganglion also sends communicating branches to the vagus, and branches to the heart. In this double way, therefore, the labyrinth has important nervous relations with the stomach, heart, and other organs.

PATHOLOGY.—Vertigo may be excited by variations in the local or general blood-pressure, which cause variations in the labyrinthine tension, as in anæmia, gout, and other affections. The symptom is also produced by certain drugs, such as quinine, salicin, and the salicylates, which act probably on the labyrinth through the vascular system.

Vertigo may be divided into degrees or stages, namely, (1) a feeling of confusion and instability; (2) a feeling as if objects are moving; (3) a feeling as if the individual himself is moving; and (4) actual movements of the body.

The important forms of vertigo which occur in practice will be further considered under the following heads: 1. **Ocular**; 2. **Auditory**; 3. **Gastric**; 4. **Nervous**; 5. **Epileptic**; 6. **Migrainous**; 7. **With organic brain-disease**; and 8. **Gouty.**

1. **Ocular Vertigo.**—Vertigo is frequently caused by ocular disorders, and is often mistaken for serious cerebral disease. The simplest form is in paralysis of a single muscle, as the external rectus. The vertigo is not occasioned by the diplopia, but by the incorrect notion formed of external objects by the paralysed eye, due to what is known as 'erroneous projection.' The confusion thereby produced gives rise to vertigo, and often to reeling. One of the most important varieties of ocular vertigo is that occasioned by insufficiency of the internal recti muscles—

*muscular asthenopia*. This is most commonly met with in myopia. During reading these muscles, which have long been overtaxed by exertions to maintain the convergence of the eyes rendered necessary when looking at near objects, suddenly give way under the strain; they relax, the eyeballs turn out, and the letters on the page become indistinct, run into each other or overlap, and a sense of confusion and giddiness occurs. It is usually accompanied by aching at the backs of the eyes, headache, and sometimes by nausea. Such cases are often misunderstood even by medical men. Muscular asthenopia may occur also with hypermetropia; and as a sequel to exhausting diseases, such as fevers and diphtheria. For the diagnosis of the particular optical defect and treatment the reader is referred to Vision, Disorders of.

2. **Auditory or Aural Vertigo.**—Synon.: *Vertigo ab aure læsa*; Labyrinthine vertigo; Apoplectiform vertigo; *Menière's Disease*.

Auditory vertigo is very generally known by the name of Menière's disease, from the excellent description of the malady first given in 1861 by Menière. Under the term Menière's disease is grouped a class of cases in which vertigo is caused by perversion or abeyance of the labyrinthine function. The labyrinthine disturbance may be caused either (1) *directly* by an affection of the labyrinth, such as (*a*) hæmorrhage, (*b*) congestion and inflammation; or (2) *indirectly*, by (*a*) disease of the middle ear (otitis media), (*b*) obstruction of the Eustachian tube, (*c*) spasm of the tensor tympani, or paralysis of the stapedius, or (*d*) irritation or obstruction of the external auditory meatus, and pressure on the membrana tympani, as by cerumen, foreign bodies, or by syringing the ears, especially when the membrana tympani is perforated. Thus the labyrinthine affection may be either of an irritative or of a destructive nature, and the effect of the lesion will be exactly the reverse in the two cases (Ferrier). That is to say, whilst an irritative lesion would cause the tendency to fall in one direction, a destructive lesion of the same canal would cause a tendency to fall in the opposite direction. In Menière's disease, strictly speaking, there is always coincident affection of the semicircular canals and cochlea, as indicated by the three most important associated symptoms: vertigo, tinnitus, and deafness. Accompanying these cardinal symptoms there are accessory phenomena, due to secondary visceral disturbance, namely, pallor, faintness, and nausea or vomiting—a condition of syncope.

The disease makes its appearance, in a person apparently quite well, or the subject only of some chronic auditory disease, with a loud noise in the ear, compared by different persons to the whistle of a steam-engine, the firing of a gun, or the roar of the ocean. When a person, as not infrequently happens after the first attack, has an habitual noise in the ear, this at the time of the attack is greatly exaggerated. The noise, which is wholly or principally in one ear, is soon followed by the feeling of giddiness. This is generally of a high grade, causing the sensation of surrounding objects moving in some one direction, a feeling of translation of the patient's body in the same direction, or actual movements of the body. The movement, whether apparent or real, is usually *from* the side on which the ear is affected. In recurring attacks the movements, whether of objects or of the individual, are nearly always in the same direction. Usually the sensation of movement is from behind forward, or to one or the other side, or the patient has a feeling of rotation in a vertical axis. When in bed, the room, bed, and occupant are felt as if turning round and round, or rising or sinking. Accompanying the vertigo there is reeling, and the patient clings to surrounding objects for support. In some cases the movement is too rapid for the patient to obtain security in this way, and he is thrown to the ground, sometimes with such violence as to occasion serious injuries. When falling takes place, it is usually forwards or to one side. It is, however, to be especially remembered that, except in rare cases, there is no loss of consciousness; the patient being able immediately after the attack to describe the sensations he experienced, or even to answer questions in the attack itself. Following, in more or less rapid succession, the tinnitus and vertigo, there occur nausea and in most cases vomiting, accompanied by pallor of the face; the skin becomes cold and covered with a clammy sweat. In some cases oscillatory movements of the eyes are observed. It is generally asserted that objects appear to move in a direction opposite to that of the ocular movements. This is not universally true; and probably, contrary to the statements of most writers, the apparent movements of objects is in the same direction as the observed movements of the eyes. Gradually the attack passes off; the noises in the ear lessen, but deafness is left behind. The body recovers its warmth, and the pallor subsides, but vertigo and vomiting may persist for some hours or even days, both being aggravated or induced by rising from a horizontal position. Slight attacks may only last a few minutes. In cases where there is a direct lesion of the labyrinth, a certain degree of deafness—a limitation of the field of audition, that is, the loss of certain sounds in the musical scale—and tinnitus remain. The patient is in all other respects well, except for the dread of a recurrence of the attack. Occasionally, however, a certain degree of vertigo and reeling persist, liable to be aggravated by gastric derangement. A patient rarely escapes with one attack. Subsequent attacks are separated by distinct intervals, but in severe cases these may become less and less, until a permanent vertiginous state, of a most distressing character, may be reached, liable to paroxysmal exacerbations. In such very grave cases spontaneous cure may occur on the establishment of complete and permanent deafness, or relief may be obtained by therapeutical measures. When the labyrinthine disturbance is secondary to disease of some other part of the auditory apparatus, removal of the primary disease, as cerumen or tympanic catarrh, will, when practicable, promptly remove the symptoms, and the attacks may not recur.

Diagnosis.—Menière's disease has to be distinguished from epilepsy, apoplexy, gastric derangement, and other causes of vertigo. From

all of these it is distinguished by the invariable coexistence of tinnitus, deafness, and vertigo, with in addition syncope and nausea, or vomiting. The concurrence of the first three symptoms shows that the labyrinth is involved, a point which will be further established by testing audition with a tuning-fork and watch. The vertigo is generally of movement in a certain definite and uniform direction. There is never numbness, tingling, or any sensations analogous to an aura; but aching of the upper extremities, and discolouration of the hands may occur, from irradiation of the irritation from the inferior cervical ganglion to the brachial plexus (Woakes). As to the diagnosis of the nature of the labyrinthine affection, whether primary or secondary, some rules have been laid down by authorities. If a person who has formerly heard well becomes suddenly deaf, or hard of hearing, with the symptoms of an apoplectic attack, and if there is at the same time an uncertain and staggering gait, but no symptoms of paralysis in the nerve-tracts, and if the examination shows a normal membrana tympani, and perfectly permeable Eustachian tube, we may believe with great probability that there is an affection of the labyrinth (Tröltsch). Deafness and tinnitus occurring without vertigo indicate an affection of the middle ear. Vertigo and tinnitus without deafness may be due to an affection of the middle ear. Vertigo, tinnitus, and deafness are certainly due to an affection of the labyrinth. Careful otoscopic examination should be made, the permeability of the Eustachian tubes tested, and the tuning-fork and watch employed to ascertain the condition of the conducting apparatus, before an exact opinion can be formed as to the nature of the labyrinthine affection. Vomiting, following the ingestion of some rich or indigestible food, may be so severe and lasting as to monopolise attention, and the vertigo and tinnitus may not be complained of. In such a case, a mistake may readily occur in a first attack.

Prognosis.—Where the labyrinthine affection is due to some remediable defect, the disease will subside on removal of the cause, such as cerumen, tympanic catarrh, &c.; hence the great importance of an exact diagnosis as to the nature of the case. When the lesion is primarily of the labyrinth, a certain degree of deafness and tinnitus is nearly always left, and recurrence of the attack is to be anticipated.

Treatment.—In the attack, and for a short time following it, the recumbent position should be strictly maintained. Bromide of potassium or ammonium, in ten to twenty grains for a dose, may be administered, and small pieces of ice swallowed. Next, any gastric derangement should be corrected, for in some cases gastric affection excites a paroxysm in a person predisposed to it by some aural affection, insufficient alone to induce an attack. Alkalies and vegetable bitters, with or without bismuth, will generally be useful for this purpose. Any abnormal local condition must be treated. Subsequent to the attack quinine in full doses, 3 to 5 or 10 grains three times a day, perseveringly used, is sometimes attended with the best results (Charcot). Gelsemium and salicylate of soda have been found useful (Gowers). Counter-irritants, including the actual cautery, applied to the mastoid region, have proved serviceable in some cases, and may be used in addition to other measures.

3. **Gastric Vertigo.**— Synon.: *Vertigo a stomacho læso.*

Vertigo, occasionally of a high grade, sometimes accompanies chronic gastric derangement. It is more common with slight than with grave affections of the stomach, but has been met with in well-marked organic disease of this organ. An explanation of its occurrence has been given in the introductory remarks. It sometimes occurs soon after a meal, but more often when the stomach is empty (Trousseau). Associated with it are usually pain and a feeling of fulness in the stomach, increased by food; heartburn; eructations; vomiting; flatulence; and pain in the left hypochondrium and chest. The bowels may be torpid, or diarrhœa may be present. The patient often suddenly experiences a swimming in the head, objects may appear to revolve, the patient's gait becomes tottering, and he may even fall. Often there is constrictive headache, faintness and pallor with nausea, and sometimes troublesome vomiting, but there is no loss of consciousness. Visual hallucinations may be present, and buzzing in the ears experienced, but there is no deafness. The vertiginous symptoms may so predominate that the gastric symptoms may not be complained of, but treatment directed against dyspepsia cures the vertigo. When predisposing gastric disturbance is present, trivial causes, such as looking at objects which lead to confused visual impressions, may excite an attack, but this may also arise spontaneously. In many cases relief is obtained by the recumbent position, but attacks may occur when the patient is lying down.

Diagnosis.—This form of vertigo is diagnosed from epilepsy by absence of loss of consciousness; and from labyrinthine vertigo by the absence of deafness, and the physical signs of aural disease. It cannot be concluded that the vertigo is essentially gastric without thorough examination of the ears, for, as already stated, vertigo may be excited by gastric disturbance when there is labyrinthine affection insufficient alone to determine an attack. It must also be remembered that signs of gastric and intestinal derangement are induced in Menière's disease, and may be so prominent as to cause the aural affection to be overlooked.

4. **Nervous Vertigo.**—Synon.: Fr. *Vertige nerveuse.*

Not uncommonly vertigo is one of the most troublesome symptoms of nervous exhaustion and depression. This occurs in persons unduly taxing their nervous powers, by severe intellectual strain, especially when combined with anxiety, or by sexual excesses. It occurs also from the depressing effects of the immoderate use of tobacco, alcohol, and tea. The vertigo rarely reaches a high grade, manifesting itself by a sensation of confusion, or of objects revolving, occasionally only by the feeling of a tendency to fall. It may be associated with a slight reel, but more often the patient feels as if he were walking unsteadily, when there is no perceptible peculiarity of gait. As a rule

giddiness is only experienced in the upright position, but in some cases it occurs when the subject is recumbent, and the patient often complains of sudden and violent startings when just in the act of falling asleep. It is often intensified by an elevated position, and in large buildings and assemblies. Hence it is often experienced in church. It is peculiarly distressing, owing to the sufferer's emotional equilibrium being easily disturbed, and is frequently associated with a dread of impending cerebral disease—epilepsy, apoplexy, insanity, etc. There often coexist gastric derangement and flatulence, with irritability of the heart, palpitation, and sleeplessness, the former no doubt having a share in its production. There may be slight and temporary buzzing in the ears, but deafness is absent, and no loss of consciousness occurs. In these respects it is readily distinguished from Menière's disease and *petit mal*.

Treatment.—This is to be treated by removal of the cause—over-work, excessive sexual indulgence, or the abuse of alcohol, tobacco, or tea; by correction of any dyspeptic symptoms; and by the administration of nervine tonics, such as iron, quinine, or strychnia. Bromides should be avoided if possible.

5. **Epileptic Vertigo.**—Vertigo may occur in a slight fit of epilepsy, or at the commencement of a severe attack. The symptom may replace an epileptic fit, or may coexist with epilepsy. It is more common in epileptic vertigo for the patient to imagine that he himself is moving or turning round, than for external objects to appear in motion (Russell-Reynolds). Care must be taken not to accept the patient's mere statement of 'giddiness.' The term is often loosely applied. It is necessary to ascertain his exact sensations, and only to conclude there is vertigo when actual feelings of movement are experienced. If the vertigo is related to change of position of the head, it is probably labyrinthine. The latter is not usually accompanied by loss of consciousness, and is more apt to be followed by vomiting (Gowers).

6. **Migrainous Vertigo.**—Vertigo commonly constitutes one of the phenomena of migraine, occurring as a rule after the disorders of sight, touch, and speech, when these form part of the seizure, and either attends or follows the development of the headache (Liveing). Vertigo sometimes replaces the attacks of migraine. It is apt to occur on change of posture, or on suddenly turning the head. As a rule migrainous vertigo is slight in degree, but it may be quite severe, and accompanied by nausea and vomiting. It is unassociated with noises in the ear, or with deafness. *See* Megrim.

7. **Vertigo in connexion with organic disease of the nervous system.**—Vertigo sometimes accompanies disease of the cerebrum, both acute, as apoplexy, and chronic, as tumours. There are reasons for believing that vertigo may be excited by cortical lesions, thus explaining epileptic and migrainous vertigo. Disease of the cerebellum and of its middle crura are often attended with reeling gait, and sometimes with vertigo. This symptom sometimes accompanies the ataxy of tabes dorsalis; and is a marked symptom of some cases of insular sclerosis.

8. **Gouty Vertigo.**—Vertigo, labyrinthine or other, is occasionally met with in gouty persons. It may disappear after an outburst of gouty arthritis; or be removed by alkalies, colchicum, and other proper remedies, and attention to diet.

Stephen Mackenzie.

**VESICAL DISEASES.** *See* Bladder, Diseases of.

**VESICANTS** (*vesico*, I blister).—A class of counter-irritants which produce blisters. *See* Counter-Irritants.

**VESICLE** (*vesicula*, diminutive of *vesica*, a bladder).—Synon.: Fr. *Vesicule*; Ger. *Bläschen*.

Definition.—An elevation of the corny layer of the epidermis, caused by a minute circumscribed collection of serum or sero-pus, between it and the mucous layer beneath.

Description.—Vesicles may be minute or of considerable dimensions; a vesicle of the size of a millet-seed gives the name to the cutaneous affection *miliaria*. The vesicles of eczema are minute and frequently confluent; those of scabies are occasionally acuminated; the vesicles of varioloid are not uncommonly umbilicated; those of herpes iris are developed in rings; the vesicles of ordinary herpes attain the bulk of a split pea; and the vesicles of pemphigus, on account of their large size, are called 'bullæ.' The contents of a vesicle are apt to modify its name, since a vesicle containing a purulent fluid or pus is termed a 'pustule.' The ordinary course of a vesicle is to lose its fluid by evaporation, absorption, or rupture of the distended cuticle; to dry up into a thin scale; and to terminate by desquamation, without further lesion of the skin.

Treatment.—The treatment of vesicles is fully described under the heads of the several diseases of which they are a symptom. *See* Chicken-pox; Herpes; Miliaria; and Pemphigus.

Erasmus Wilson.

**VESICULAR EMPHYSEMA.**—A form of emphysema of the lungs, in which the alveoli are distended with air. *See* Lungs, Emphysema of.

**VIABLE** (*vie*, life).—Synon.: Fr. *Viable*; Ger. *Lebendig*.—An epithet applied to a newly-born child, to indicate its capacity for maintaining an independent existence. Viability has chiefly to be determined by the age of the fœtus, and by its condition as regards formation, health, and strength (*see* Fœtus, Diseases of). It has also been supposed to depend in some measure upon the season of the year in which a child is born (*see* Periodicity in Disease). The question of viability has important medico-legal bearings, for which reference must be made to works upon forensic medicine.

**VIBICES** (*vibex*, a wale).—Synon.: Fr. *Vergetures*; Ger. *Striemen*.—A term applied to patches of discolourisation on the surface of the body, somewhat resembling the marks of stripes or wales, and due to the presence of altered blood in the part. Vibices may arise either during life, as the result of a variety of causes (*see* Extravasation); or after death, as one form of cadaveric lividity or hypostasis. *See* Death, Signs of.

**VIBRATION.**—This word is sometimes employed as a synonym for fremitus. *See* Fremitus.

**VIBRIO** (*vibro*, I shake).—Synon.: Fr. *Vibrion*; Ger. *Zitterthierchen*. *See* Bacteria.

**VICARIOUS** (*vicarius*, in place of another). This word signifies substitution, and in physiology and pathology implies that some part or organ performs certain functions, or is morbidly affected, instead and in the place of some other part or organ, thus becoming a substitute for it. The notion of vicariousness is chiefly associated with a discharge of blood, whether physiological or morbid. Thus, it is very common to speak about *vicarious menstruation*, which is understood to mean that the discharge of blood which takes place normally from the uterus at the menstrual period, either does not occur at all, or only imperfectly, and that its place is taken by hæmorrhage from some other part, evidenced by epistaxis, hæmoptysis, hæmatemesis, or other forms of bleeding. The same idea is extended to morbid hæmorrhages, such as bleeding from piles, when this becomes habitual in an individual at frequent or regular intervals. It is supposed that bleeding may sometimes take place from other parts as a vicarious hæmorrhage, instead of from the hæmorrhoids.

Again, discharges, whether normal or morbid, as of secretions, mucus, pus, or other materials, are believed by many to exhibit a vicarious relation to each other in some instances, coming from one part while ceasing or diminishing at another, and so on. This may be illustrated by expectoration and diarrhœa in phthisis, which appear to modify each other as to their amount in some cases of this disease. Further, secretions and excretions are regarded as acting vicariously with reference to each other. Thus some of the secretions of the alimentary canal are undoubtedly capable of acting mutually as substitutes, and this may be looked upon as an instance of vicarious action; while such a connection existing between the perspiration and urine is generally recognised.

Certain morbid conditions are also considered as having a vicarious relation. For example, congestion of or hæmorrhage from one part may take the place of congestion at another; or inflammation in one region may be the substitute for inflammation in another region.

There is probably more or less truth in these notions of vicariousness, as applied in relation to physiology and pathology. In actual practice, however, no case ought to be regarded as belonging to this category, without careful and thorough investigation. It has happened that hæmorrhages supposed to be vicarious of menstruation, have been important signs of grave diseases, such as gastric ulcer, or pulmonary phthisis. The principle may be of value in certain conditions as an indication for treatment.

Frederick T. Roberts.

**VICHY, in France.**—Thermal alkaline waters. *See* Mineral Waters.

**VIGILIA.**—Wakefulness; a term formerly applied to conditions of insomnia, but now little used and almost obsolete. *See* Sleep, Disorders of; and Coma-Vigil.

**VILLOUS GROWTH** (*villus*, hair).—Synon.; Fr. *Villeux*; Ger. *Villös*; *Zottig.*—A growth composed of hypertrophied villi. *See* Tumours.

**VIRGINIA SPRINGS, in Virginia, United States.**—Sulphur waters. *See* Mineral Waters.

**VIRULENT** (*virus*, a poison).—Primarily this word signifies connected with virus or poison. It is generally, however, employed to indicate great intensity or malignancy of disease; for example, *virulent inflammation*, *virulent bubo*, and *virulent small-pox*.

**VIRUS** (Lat.).—Literally this word signifies a poison, but in medical language it is used to designate any kind of contagious material. *See* Contagion.

**VISION, Defects of.**—Synon.: Fr. *Troubles de la Vision*; Ger. *Sehenstöhrungen*.

Sight may be defective as to perception of *form*, of *colour*, or of *light*; and the whole, or only a part, of the *visual field* may be affected. Sight is also disordered whenever *binocular single vision* becomes difficult or impossible (*see* Strabismus); and when *visual endurance* is impaired. The terms 'vision' and 'sight,' as commonly used, indicate acuteness of vision, and refer to the perception of form at the yellow spot. In this article disorders (A) of **perception of light**, (B) **of perception of colour**, and (C) of the **visual field**, will be shortly alluded to; but attention will be chiefly given to (D) disorders of **acuteness of vision** caused by optical defects in the eyes.

A. **Disorders of Perception of Light.**—Perception of light is equally good in all parts of the retinal area, except the most peripheral zone, which appears to be blind.[1] Impaired perception of light causes disproportionate defect of vision by dull light—'night-blindness' (*see* Nyctalopia). It may affect the whole field, or only its periphery. It occurs chiefly in diseases of the outer layers of the retina, especially syphilitic retinitis, and retinitis pigmentosa. Lowered light-sense over the whole field occasions the symptoms in the peculiar disease known as functional or endemic nyctalopia (*torpor retinæ*). The opposite condition, day-blindness (*see* Hemeralopia), with true retinal photophobia, is much rarer and more obscure. It is usually congenital, and accompanied by nystagmus, amblyopia, and colour-blindness; and acuteness of sight, which is defective, is best by dull light.

B. **Colour-Blindness.**—Synon.: *Dyschromatopsia; Achromatopsia.*—This, when congenital, is usually not related to any other defects of vision. Congenital colour-blindness occurs with greater intensity and far greater frequency in males than in females (M. 3 to 5 per cent.; F. ·2 per cent. or less). It is shown by more or less want of power to distinguish between certain complementary colours. Red and green are the two commonly confused, the perception of blue and yellow being but rarely affected. Blindness for all colours is very rare except as the result of disease. There are many degrees of colour-blindness. A red-green-blind person sees in the spectrum only two colours, separated by a neutral stripe, which is placed somewhere in the greenish-blue; all the colours on the side of the red ('warm' colours)

[1] Landolt, *Arch. d'Opth.*, i. 203, 1851.

are confused together, and all on the side of the violet ('cold' colours), but the warm and the cold are never confused (Donders).[1] In incomplete red-green-blindness, green, bluish-green, and often rose are confused with grey of corresponding shade, and red is confused with shades of brown and greenish-brown. In a complete case full green and scarlet are confused. The best test for ordinary use is the one due to Holmgren of Upsala, in which a skein of Berlin wool, of a particular colour and shade (green, rose, or red), is given to the patient, and he is required to match it with all the others which seem to him of the same or a similar colour, amongst a large bundle of skeins of many colours. He is not usually allowed to name the colours, because even the colour-blind often guess the colours of common objects correctly. A very pale, pure green is the first test used, and the colour-blind, even of slight degrees, will match with it not only other green skeins, but also shades of pale grey, buff, and pink. Slight cases may easily be overlooked, unless the wools are carefully selected, and the examiner practised. Stilling's plates of coloured letters, printed on a groundwork of complementary colours, are also very valuable. Red and green are not well seen under ordinary circumstances, even by the normal eye, except at the central part of the visual field (*i.e.* the field for these colours is smaller than for white; but even at the periphery these colours are recognised if very brightly lighted and of large size.[2] Acquired colour-blindness often comes on in degenerative or inflammatory diseases which begin in the optic nerve. It is much less common in diseases of the retina, and in glaucoma. Like the congenital form, it usually concerns only, or chiefly, red and green. It may affect the whole visual field of these colours, or only certain parts, a gap, or 'scotoma,' being present, on whose area the red and green are not perceived in their true colours. When acquired colour-blindness is well-marked in the whole extent of the field, in cases of disease of the optic nerve, the prognosis for sight is generally very bad; but if it be localised on a central scotoma, even though it there reach a high degree, the prognosis is usually good. Progressive atrophy of the optic nerve, however, occasionally reaches a very high degree without any colour-defect.

C. **Disorders of the Visual Field.**—The visual field is the whole surface visible to one eye singly whilst at rest. It forms a concave surface, all the points of which are equidistant from, and perpendicular to, their corresponding points on the retina. In the outward and downward part it reaches to 95° from the centre; inwards, upwards, and downwards only to about 60°. Projected on a flat surface it thus forms an oval. The centre of the field ('fixation point') corresponds to the yellow spot, and the 'blind spot' is about 15° outwards from this point. In order to measure the field roughly, the patient, placed with his back to the light and covering one eye, looks steadily from a distance of eighteen inches at the nose or eye of the observer, who then moves his hands about in the different parts of the field, and notes any places where the hand is invisible or badly seen. This test, carefully applied, will detect any considerable loss of the field. Or the patient may gaze at a spot on a black board about one foot off, and a piece of white chalk be moved from different points at the periphery until it just becomes visible; a line joining the various points will form the boundary of the field. For accurate measurements, however, a special instrument, the Perimeter, is necessary.

D. **Disorders of Perception of Form.**—Perception of Form, Synon.: Acuteness of Vision; *Visus*; *V.*; Fr. *Acuité visuelle*; Ger. *Sehschärfe*; *S.*—Perception of form is normal only when the image of the object looked at falls on the bacillary layer of the retina, at the centre of the yellow spot, is clearly defined, sufficiently bright, and of a certain minimum size.

Principles.—The size of the image depends (1) upon the size of the 'visual angle' enclosed by the two lines drawn from the extremities of the object to the 'nodal point' just behind the crystalline lens; and (2) on the distance of the nodal point from the retina, which in the normal eye is 15 mm. The form of any letter or character is distinguished by a properly formed and healthy eye, with average light, if it subtend a visual angle of five minutes, each of its separately distinguishable parts subtending an angle of one minute. If the nodal point be more than fifteen millimètres from the retina, the image will be larger, and acuteness of vision therefore increased; this occurs in myopia, and also when a convex glass is held in front of the eye. The reverse is true if the distance be less than fifteen mm., as in hypermetropia, and when a concave glass is held before the eye. Hence convex lenses always increase, and concave lenses always diminish, the size of the retinal images. Vision or 'fixation' is called *direct* or *central* when the image of the object looked at falls on the yellow spot; *indirect* or *excentric* when, in consequence of impairment of function at the yellow spot, an image falling on some other part is better seen. The clearness of the image depends (opacities of the media apart) upon the retina being exactly at the focus of the refracting (dioptric) media of the eye; it is also influenced somewhat by the size of the pupil, being, *cæteris paribus*, better when the pupil is small.

Normal acuteness of vision is expressed as unity (V. or S. = 1); subnormal vision being expressed as a fraction. Various *test-types* are in use, composed of letters, words, &c., of such a size that each subtends the minimum angle of five minutes at a certain distance. The test-types of Dr. Snellen are in most general use, and include letters visible under the standard angle at from 60 mètres to ·5 mètre. If No. 60 be read at 60 m., then $V. = \frac{60}{60}$ or 1; if No. 60 can only be seen at 6 m. $V. = \frac{6}{60}$; &c. V. therefore is expressed by a fraction whose numerator is the greatest distance at which a given type can be read, and the denominator the distance at which it ought to be seen; or the fraction may be reduced ($\frac{6}{60} = \frac{1}{10}$, &c.). The acuteness is said to become progressively lower after the age of sixty, without disease; so that at eighty it is only about $\frac{1}{2}$ (Donders).[1]

[1] Donders, *Brit. Med. Jour.*, 1880, ii. 767.
[2] Landolt, *Examination of the Eye*, p. 213.

[1] *Anomalies of Accommodation and Refraction*, p. 190.

**1. Functional Affections of the Optic Nervous Apparatus.**— Amblyopia without ophthalmoscopic changes may be permanent or temporary, and exhibit many differences in the character of the failure of sight. The positive disuse (suppression of the retinal image) of one eye, in order to avoid diplopia or the confusion sometimes caused by opacity of the cornea or other defect, leads to permanent and great defect of that part of the visual field which is common to both eyes, '*amblyopia ex anopsiâ*.' The defect is psychical, and the eye shows no changes. It is most easily acquired early in life, and may be partly remedied by separate use of the eye. In cerebral hemianæsthesia there may be blindness, or nigh amblyopia with great contraction of the field and colour-blindness in the eye opposite to the lesion, with a lower degree of the same condition in the other eye. Some rare cases of permanent loss of sight in one eye without changes, in which there is a history of previous paralytic symptoms, probably belong to this group. In *hemiopia* (properly *hemianopsia*) there is usually loss of the corresponding halves of the visual fields, vision being lost on the side opposite to the lesion; when the loss of field extends quite up to the fixation-point, affecting central vision, the lesion is probably somewhere between the chiasma and corpora geniculata; but when an area of several degrees around the fixation-point remains free, it is suggested that the lesion is cerebral.[1] Loss of both temporal halves may indicate disease at the chiasma; neither this, nor loss of both nasal halves, is frequent. In hemiopia, even of long standing, the optic discs are seldom altered. In some cases of 'hemiopia' only a quarter of each field is lost. Disease of the optic nerve at a distance from the eye causes blindness or defective sight, often at first without any ophthalmoscopic changes; but if the defect remain, signs either of inflammation or atrophy appear in a few weeks. The ophthalmoscopic changes may, however, be very slight, as is shown in the common cases of central amblyopia usually caused by tobacco-smoking, in which disease of the optic nerves has now been demonstrated; with the exception of this group, cases of retro-ocular disease of the nerve are rare.

Temporary fogginess of sight, usually with the appearance of coloured rings around a candle, occurs in the premonitory stage of glaucoma; these last from half an hour to a day or more; they do not usually occur in both eyes at once (*see* EYE AND ITS APPENDAGES, Diseases of). Attacks of megrim are often ushered in by a peculiar, transient, subjective defect of sight; a small cloud, appearing near the middle of the field, quickly spreads with a quivering movement and zigzag outline over about half the field; its borders are often brilliantly coloured; it affects both eyes; is equally visible whether the eyes are open or shut; lasts about a quarter of an hour; and is generally followed by the other megrim symptoms to which the patient is subject. But some persons merely complain of a 'cloudiness' or of 'spots' before their headaches (*see* MEGRIM). Brief attacks of blindness of one eye, coming on quite suddenly, and recurring in the same eye, occasionally take place in the subjects of heart-disease. Permanent blindness, with atrophy of disc or the appearances of retinal embolism, has at length supervened in a few of these cardiac and megrim cases.[1]

Persons who suffer from severe neuralgic pain in the fifth nerve sometimes describe dimness of the same eye during an attack, but the opportunity of verifying the statement seldom occurs. In connection with severe vertex-headache in hysterical persons, sight is sometimes very bad; one eye may even appear almost blind. There is photophobia, and there may be symptoms of accommodation-spasm, and the field is, or seems to be, highly contracted. Though it may be exceedingly difficult to say that there is conscious dissimulation, the groundless nature of the ocular symptoms is sometimes proved by the fact that acuteness of vision, even in the 'blind' eye, is at once and perfectly restored by the weakest possible lens, or by a piece of flat glass mounted to resemble a trial lens. Intentionally feigned blindness of one eye can nearly always be detected by one device or another; but pretended defect of both eyes is more difficult to expose; reference must be made to works on ophthalmology for further details.

**2. Abnormalities of Refraction.**—SYNON.: *Ametropia.*—These conditions are of importance by preventing the formation of clear retinal images; in addition they often make the sustained use of the eyes difficult or impossible (*asthenopia*). They include (*a*) *hypermetropia*, (*b*) *myopia*, and (*c*) *astigmatism*. The varieties of asthenopia will receive a short separate account after 'Disorders of Accommodation.' As ametropic conditions are remedied by optical aids, it will be convenient first to refer to the subject of spectacles.

**Spectacles.**—*Varieties of Construction and Mode of Wearing.*—Refracting spectacles are made either of crown-glass or of rock-crystal. The latter is more expensive but harder, less breakable, and rather lighter. Ordinary spectacles are biconvex or biconcave spherical lenses. Meniscus lenses are sometimes used, and are called 'periscopic' because they give a larger field. In 'Franklin' or 'pantoscopic' spectacles the upper half is made of a different focal length from the lower; they are sometimes used by persons who need distance- and reading-glasses of different strengths in the same frame. The various non-refracting protective glasses (goggles, domed glasses, horseshoe- or D-protectors, &c.) are generally included under the term 'spectacles.' The most important points in the mounting of spectacles are that the hinges should be strong, the sides long enough to hold securely without uncomfortable pressure, and that the bridge should fit the nose well. The centres of the lenses should, unless otherwise ordered, be opposite the centres of the pupils when the glasses are in use. All concave glasses and convex distance glasses should sit as close to the eyes as

[1] See Ferrier, 'Cerebral Amblyopia and Hemiopia,' *Brain*, January, 1881. The subject, however, is far from exhausted; *see* Robin, *Troubles Oculaires dans les Mal de l'Encéphale*, p. 390, 1880, Haab, *Klin. Monatsbl. f. Augenheilk.* &c., 1882, &c.

[1] Hutchinson, *Oph. Hosp. Reps.* viii. 56; Loring, *Amer. Jour. Med. Sci.*, April 1874; the author, *Brit. Med. Jour.*, June 1879; Galezowski, *Gaz. des Hôp.*, Dec. 1881.

possible; convex reading-glasses may be put further down the nose, and shaped to allow of looking over the top of the frame in distant vision.

For 'simple' astigmatism the correcting lens is a segment of a cylinder; for 'compound' and 'mixed' cases the effect of a cylindrical and spherical lens is required, and may be obtained either by combining two suitable cylindrical curvatures at right angles to each other, or by grinding the cylinder on the flat side of a plano-convex or -concave lens; they require of course to be mounted with the curvature of the cylinder exactly in the right direction. When prisms are ordered they are mounted like ordinary spectacles, and a lens may be ground upon each surface of the prism if necessary; it is not practicable to wear prisms of more than about 8°. Spherical lenses can be made to act to a varying degree as prisms, by putting them with their centres nearer to or further from each other than the pupils.

*Numbering.*—Spectacle lenses are at present numbered on two different systems, namely—(1) the *inch* scale; and (2) the *metrical* scale. (1) In the old system the refractive unit is a lens of 1-inch focal length, and the inch may be English, Parisian, or other. The lenses in use being all weaker than the unit are expressed by fractions; thus the strongest in use in the trial case being a 2-inch lens is expressed as $\frac{1}{2}$ (+ or −, according as it is convex or concave); a lens of 10 inches' focus is $\frac{1}{10}$; &c. It is desirable that the series of lenses should rise by equal refraction-intervals, and here the inch scale is inconvenient because it introduces difficult fractions. (2) The inch scale is rapidly giving place to the metrical dioptric scale, in which the measure is international, the refractive unit is a weak instead of a strong lens, and the refractive intervals are equal. The unit is a lens of 1 mètre (100 cm.) focal length, and is called one *dioptre* (1 D.) Stronger lenses are written as whole numbers; thus a lens four times as strong as the unit is 4 D.; a lens equal to half the unit is ·5 D. The disadvantage of the system is that the numbers do not, as on the inch system, express the focal length of the glasses; but the latter is easily arrived at by dividing 100 by the number of the lens in dioptres; thus the focal length of 5 D. $= \frac{100}{5} = 20$ cm.

To convert a lens made by the Paris inch into its equivalent in dioptres, multiply its inch-value by 36 (1 m. = 36 Paris inches nearly); thus, $\frac{1}{36} \times 36 = 1$ D. To convert a metrical lens into its equivalent in Paris inches divide its value in D. by 36; thus 4 D. $= \frac{4}{36} = \frac{1}{9}$.

The following are the most important equivalent numbers:—

| Dioptres (D.) | Focal length in Paris inches |
|---|---|
| ·5 | 72 (written $\frac{1}{72}$, &c.) |
| ·75 | 50 |
| 1· | 36 |
| 1·25 | 30 |
| 1·5 | 26 |
| 2 | 18 |
| 2·5 | 14 |
| 3 | 12 |
| 3·5 | 10 (nearly) |
| 4 | 9 |
| 4·5 | 8 |
| 5 | 7 |
| 6 | 6 |
| 7 | $5\frac{1}{2}$ |
| 9 | 4 |
| 11 | $3\frac{1}{2}$ |
| 13 | 3 |
| 15 | $2\frac{1}{2}$ |
| 18 | 2 |

Several intermediate numbers found in the trial cases have been omitted.

The several abnormalities of refraction and accommodation may now be discussed in due order.

*a. Hypermetropia.*—In hypermetropia the retina lies within, instead of at, the principal focus of the dioptric media. Parallel rays, such as come from very distant objects, therefore meet the retina before being focussed; and divergent rays, from near objects, meet it still more in advance of their focus. Hence the hypermetropic eye, in repose, sees nothing clearly. Distant objects can be seen clearly if, by exerting accommodation, the crystalline lens be made more convex; or if the rays, before they enter the eye, be made sufficiently convergent by passing through a suitable convex lens.

Common hypermetropia, due to flatness of the posterior segment of the eyeball, called *axial hypermetropia*, is always congenital; and a large proportion of children are hypermetropic at birth—according to Ely[1] 72 per cent. In sections the circular fibres of the ciliary muscle are, or appear to be, more abundant than in the normal eye. The cornea is not flatter, but the anterior chamber is rather shallower, and the pupil rather smaller than normal. In high degrees the eyeball is too small in all directions.

The natural remedy for hypermetropia consists in the exercise of accommodation for distant sight; when in the normal or emmetropic eye it is in complete abeyance. A proportionate increase of accommodation is required by the hypermetropic eye for near vision. The absolute quantity, amplitude, or range of accommodation is not greater in hypermetropic than in normal eyes; hence in hypermetropia it becomes sooner insufficient for the needs; and the higher the degree of hypermetropia the earlier does this occur.

Symptoms.—The symptoms depend on the patient's age, occupation, and health, and on the degree of hypermetropia. The lower degrees only exceptionally cause symptoms in child hood. The higher degrees in children, and the lower degrees in young adults, cause difficulty in reading, writing, or sewing, especially by artificial light, and towards the end of the day's or week's work–'accommodative asthenopia.' The difficulty is expressed in the forms of mistiness of sight, weariness or aching of the eyes, headache, sleepiness, watering, chronic congestion and irritation of the palpebral conjunctiva. In the highest degrees the attempt to see clearly is often given up. Such persons often partly compensate for the bad definition of the images by holding the book very close, and so increasing their size, and thus they may seem to be myopic. All the symptoms are worse when the health is low. As accommodation fails with age, a time arrives for every hypermetrope when, unless aided by glasses, no clear vision is possible at any distance; but spectacles are generally adopted before this occurs.

Concomitant convergent squint often arises in hypermetropia (*see* Strabismus). It is at first, and may remain, periodic, present only during strong accommodation; but often it becomes constant.

[1] Ely, *Knapp's Arch. d. Ophthalm.* ix. p. 4.

In either case it may alternate or may always affect the same eye. When constant and fixed the sight of the squinting eye becomes defective, as already described. This occurs most easily in squint acquired early in life. By oft-repeated separate practice of the squinting eye the defect may to a great extent be removed. The squinting eye can often be proved to have also had some original defect, as from corneal nebula or a higher degree of ametropia, which led to the other eye being used and this one being allowed to squint.

When the crystalline lens is absent (*aphakia*) the eye is very hypermetropic. Distant vision is restored by means of a convex lens of 10 or 11 D. ($3\frac{3}{4}$ or $3\frac{1}{2}$ inches) held about half an inch in front of the cornea; objects at, say, 25 cm. (10 inches) are clearly seen through a lens of about 15 D. ($2\frac{1}{4}$ inches). Accommodation is abolished in the aphakic eye; but if the pupil be round and movable, its contraction aids a little in near vision, by cutting off the peripheral rays of light.

From the age of 55 and onwards the normal eye acquires a low degree of hypermetropia, owing to a change in the refraction of the crystalline lens.

Glaucoma is commoner in hypermetropic than in normal or myopic eyes. The habitual use of glasses by hypermetropic persons from early life may aid indirectly in preventing this disease.

Diagnosis.—The diagnosis is made subjectively by testing with glasses, or objectively by the ophthalmoscope. The former is the more generally useful. Even distant objects are seen indistinctly by the hypermetropic eye with relaxed accommodation; but they are made clear if a suitable convex lens be held in front of the cornea. 1. This test is easy to apply when the ciliary muscle is temporarily paralysed by atropia, or abolished by natural senile changes. 2. But when it is active the matter is less simple. The old-standing habit of exerting accommodation whenever clear vision, even at a distance, is needed, in many cases inseparably connects the effort to see, with the action of the ciliary muscle. Such persons cannot relax their accommodation when looking through a convex lens at a distant object. The effect of the lens is therefore added to, instead of substituted for, that of the accommodation, and distant vision made worse; no hypermetropia can be found by trial with glasses, it is entirely 'latent' (*H.l.*). 3. Between these extremes we find a large number who can partially relax their accommodation for distance in favour of a convex lens, but still use a part. They see well, or perfectly, in the distance without aid; they see equally well or better with convex lenses up to a certain strength. If now the accommodation be suspended by means of atropia we shall often find a higher degree of hypermetropia. The part that can be detected when accommodation is active is the 'manifest' (*H.m.*); the sum of the 'manifest' and the 'latent' is the 'total' (*H.*).

In testing hypermetropia, the patient being not less than ten feet from the test-types, we begin with a very weak convex lens, and if vision is *not made worse*, try successively higher lenses until we reach the highest which allows the best attainable vision. This lens represents the manifest hypermetropia if accommodation be present, the total if it be absent. A stronger lens causes indistinctness by bringing the focus in front of the retina. In general the younger the patient the less is the manifest in proportion to the latent hypermetropia, even though troublesome asthenopia be present.

Hypermetropia is diagnosed by the ophthalmoscope if an erect image of the fundus is easily seen when the observer is at a distance of 18 inches or more from the patient. The image is seen equally well when the observer comes as close as possible to the patient; and if he possess a 'refraction' ophthalmoscope, he can *in this position* measure the degree of hypermetropia by finding the strongest convex lens through which the details of the fundus still look perfectly clear. In this test the accommodation of both persons must be fully relaxed; the observer has to learn to do this, but the patient generally relaxes his ciliary muscle at once in the dark room, even though he could not do so when tried with glasses for the distant types.

Another test, *keratoscopy* or *retinoscopy*, is based on the fact that when light is thrown by the ophthalmoscope into the eye at a distance of three or four feet, slight rotation of the mirror causes a shadow to move across the illuminated field; in hypermetropia the shadow moves in the opposite direction to the rotation of the mirror. The method is sometimes useful in young or unruly children, and in skilled hands affords the means of a tolerably accurate determination.

The optic disc in hypermetropia, especially in children, often seems, and sometimes is, hazy, and is sometimes too red; and the retinal arteries are often too tortuous.

Treatment.—Treatment is necessary for hypermetropia whenever there is asthenopia, and when strabismus has arisen. Convex spectacles are ordered which, according to circumstances, neutralise a part or all of the hypermetropia, and are worn constantly, or only for near work. Periodic squint may always be cured by the constant use of fully correcting glasses; but in most cases where it has become constant, an operation is necessary (*see* Strabismus). In children with asthenopia it is usually best to order glasses for constant use, which correct almost the whole hypermetropia; but, if the symptoms are in connection with weak health and the hypermetropia be slight, the temporary use of glasses for near work alone is enough. Young adults using glasses for the first time are often satisfied with those which neutralise only the manifest hypermetropia, using them for all near work; but after some weeks or months asthenopic symptoms often recur, we find that there is more manifest hypermetropia than before, and are obliged to order stronger glasses. But ophthalmoscopic estimation will, as stated above, generally tell us correctly almost the total even at the first examination; and when this method makes it clear that the total is much greater than the manifest hypermetropia, glasses of nearly the full strength should be ordered at once. On theoretical grounds it is undoubtedly best for glasses to be worn constantly by hypermetropes, so that the accommodation may always

be at rest. But a good deal of latitude must be allowed to grown-up patients in regard to wearing them for distance, unless there be constant asthenopia, and this especially with elderly persons.

Acuteness of sight is usually normal in corrected hypermetropia. In many cases of high degree, where vision is, both with and without glasses, subnormal, some astigmatism is also present; but cases occur where the defect cannot be thus accounted for, and it is then assumed to be due to defective development of the eye. But probably want of education of the retina in the perception of clear images in a great degree accounts for the phenomenon.

*b. Myopia.*—In myopia the retina lies beyond the principal focus of the dioptric media, generally on account of lengthening of the posterior part of the eye—*axial myopia*; it is consequently at the conjugate focus of a point at some definite distance in front of the eye, which indeed is the 'far point,' or greatest distance of distinct vision of the eye in question. The greater the elongation of the eye, the nearer is the 'far point,' the 'shorter' the sight, or the higher the degree of myopia. By using accommodation objects can be seen at a still shorter distance.

Ætiology.—Myopia is comparatively seldom present at birth. The elongation usually comes on between about seven and fifteen years of age; progresses for a time; and stops between puberty and adult age. Myopia is often hereditary, and inheritance doubtless accounts entirely for some cases of very severe myopia where none of the other causes have operated. But habitual use of the eyes upon very close work, especially in a stooping posture, aids very strongly in its production. Its onset is sometimes determined by a severe illness in childhood. It often comes on after severe keratitis with choroiditis in children.

Myopia may also be caused by increased curvature of the cornea after keratitis, and is an invariable result of 'conical cornea.' Certain changes in the lens in the early stages of senile cataract sometimes produce myopia, even of considerable degree; and, as this form of myopia does not, like axial myopia, influence the prognosis, its possibility should always be borne in mind in a case of incipient cataract.

Anatomical Characters.—The elongation occurs chiefly in the posterior part of the eye, and especially at the yellow-spot region. The sclerotic and choroid are thinned in proportion to the distension, and the choroid often locally atrophied. The term 'posterior staphyloma' is given to the bulging region; in high degrees the eye is enlarged, and its coats are thinned, in all directions. The term 'sclerotico-choroiditis posterior' is also used to indicate the supposed nature of the change. In high degrees, particularly late in life, the vitreous often becomes fluid and contains opacities; hæmorrhages may occur from the choroid; and there is a strong predisposition to detachment of the retina and to cataract. In the ciliary muscle of myopic eyes the circular fibres are deficient or wanting. The anterior chamber is often deeper, and the pupil larger than usual. Owing to their large size highly myopic eyes are often prominent; and chiefly from the same cause their mobility is somewhat impaired.

Symptoms.—A low degree of stationary myopia usually causes no inconvenience. In the higher degrees advice is sought, either because distant sight is bad, or near work has to be held inconveniently close; or on account of eyeache, headache, watering, photophobia, or dimness; or for insufficiency of the internal recti (muscular asthenopia), or actual divergent squint. In the highest degrees divergent squint is nearly always present at the natural distance of distinct vision, and possibly even for distance; and in much lower degrees there is often difficulty in keeping up convergence, and consequent pain, tension, and weariness. Aching shows that the myopia is increasing; it is always made worse by use of the eyes, but is often present even when at rest in bed; it may accompany the development of a squint, or of detachment of the retina. Myopic eyes, even of low grade, are often intolerant of bright light. Acuteness of vision is frequently sub-normal in high degrees, especially in old people; such defect when not accounted for by visible structural changes, is assigned to irritative congestion of the choroid.

Diagnosis.—A myopic person with healthy eyes can read the smallest print fluently at his own 'far-point' (*see below*), but not further. He gains perfect distant vision by looking through a concave lens, which gives to rays of light from distant objects a divergent direction, as if they came from his natural 'far-point.' Placing him not less than ten feet from the test types we find experimentally the *weakest* concave lens that gives the best attainable vision. A stronger lens over-corrects the myopia, producing hypermetropia, which, in its turn, is corrected by the exercise of accommodation.

Myopia is diagnosed objectively as follows:—(1) When by direct ophthalmoscopic examination at a long distance, an image of the fundus is seen, which, on the observer moving his head from side to side, seems to move in the opposite direction. This image disappears when the observer comes near to the eye examined. (2) When by direct examination close to the patient, a clear image (erect) can be obtained only by placing a concave lens behind the mirror; the *weakest* lens which gives a clear image being the measure of the myopia. (3) When in indirect examination the size of the ophthalmoscopic image increases on withdrawing the objective lens from the patient's eye. (4) By keratoscopy, the shadow moving in the same direction as the rotation of the mirror.

The ophthalmoscopic changes depend chiefly on the atrophy of the choroid, which so often takes place on some part of the staphylomatous area. The commonest change is the 'myopic crescent,' a patch of yellowish-white colour (exposed sclerotic), due to atrophy of the choroid at the true outer border of the optic disc. It is sometimes seen in eyes not myopic. When more advanced it extends all round the disc (annular staphyloma). There may also be separate patches of atrophy, or a large area of partial wasting, at the yellow-spot. In high myopia with

abrupt bulging of the tunics, the disc is often tilted and then looks oval, and its outer side often becomes pale.

Course and Prognosis.—Axial myopia cannot diminish. Though its increase as a rule ceases about the same time as the cessation of the bodily growth, it may continue, or may take a fresh start later in life, especially if the health be bad, or the eyes be excessively used for fine work. But often its course seems to depend upon causes which are not under direct control; for we see myopia of high degree, leading to disastrous results, or blindness, in persons who have never learnt their alphabet, or strained their eyes in any way; and, on the other hand, it is common to meet with very myopic people, of studious habits and advanced age, in whom the eyes have not changed since youth. In general the prognosis is worse the higher the degree, the older the patient, and the feebler the health.

Treatment.—Much may doubtless be gradually done to prevent the acquisition and transmission of myopia, by improvements in the lighting of school-rooms, and construction of seats and desks, and by the choice of well-printed books. During the progress of myopia the time given to school-work should, whenever possible, be shortened; and if the disorder be quickly increasing, or if there be much aching or irritation, rest of the eye should be insisted upon for several months, or longer. Myopic children should use their eyes only as much as is comfortable, and should be forbidden to read fine print, to read by bad light, or to stoop. If there be severe aching and intolerance of light, or rapid increase of the myopia, especially with diminished acuteness of sight, prolonged rest, subdued light (or smoked glasses), and the use of the artificial leech at intervals of a few days, with derivative treatment, are of service, at least in relieving the symptoms and improving vision for a time.

The corrective treatment consists in the use of concave glasses. Myopic children should as a rule wear glasses for distance merely on educational grounds. These glasses may fully correct the defect, but it is better that they should be a little under than over the full strength. If there be muscular asthenopia, the glasses often cannot be continuously worn, unless treatment be also directed to the internal recti. Adults may use their own judgment as to wearing distance-glasses. For near work it is seldom safe, except in low degrees, to allow the fully correcting glasses, because their use calls into powerful action the function of accommodation, hitherto but little needed by the myopic eye, and also deranges the relation between this function and convergence of the visual lines. They also cause difficulty by diminishing the retinal images. If their use be persisted in for reading, &c., they may act indirectly in increasing the myopia. When the natural far-point in myopia is not nearer than 13 inches (33 cm.) reading glasses are seldom required. But for higher degrees it is often necessary to order spectacles which partly correct the myopia, that is, make the eyes less myopic, and thus remove the far point further off and allow the patient to read, &c., without stooping. As a general rule, subject to the peculiarities and needs of each case, about half the full correction may for this purpose be safely and comfortably used. For music or painting a rather stronger pair of spectacles are sometimes required. When there is muscular asthenopia, shown by the fact that in near vision one eye, if covered, deviates outwards, relief may often be given by combining prisms with their bases inwards, with the reading glasses; the prisms, by allowing the convergence to be lessened, relieve the internal recti.

*c. Astigmatism.*—Astigmatism may be *regular* or *irregular*. *Regular* astigmatism depends upon the refracting surfaces of the eye, chiefly of the cornea, not being spherical, but having different curvatures, that is, focal lengths, in different meridians, the meridians of greatest and least curvatures ('chief' or 'principal' meridians) being always at right angles to each other, and the others having regularly intermediate curvatures. The meridian of greatest curvature of the cornea is generally vertical or nearly so. The astigmatism of the lens, though less regular than that of the cornea, tends to correct the latter. In 'simple' astigmatism one chief meridian is normal, the other either myopic or hypermetropic; when 'compound' both chief meridians are myopic, or both hypermetropic, but in different degrees; when 'mixed,' the eye is hypermetropic in one chief meridian, and myopic in the other. When the focal difference between the chief meridians, or the degree of astigmatism, is not greater than is represented by a lens of 72 inches' focus (·5 D.) it may generally be neglected; and much higher degrees often cause no trouble.

Astigmatism is to be suspected in all cases of ametropia where spherical lenses do not raise vision to the normal, no other cause of the defect being found. It is detected subjectively by numerous tests, most of which consist essentially of straight lines running in various directions, some of the lines being seen by the astigmatic eye better than others. It can also be detected and measured by the ophthalmoscope. It is corrected by cylindrical lenses which neutralise the difference of refraction of the two chief meridians; but in the higher degrees acuteness of vision often remains even then subnormal. *Irregular* astigmatism can seldom be remedied.

3. **Anisometropia.**—This signifies different refraction in the two eyes, and is a very common condition, the difference sometimes being extreme. When one eye is normal and the other myopic, each may be, and often is, used for vision at different distances, and each remains perfect; but if one be astigmatic, or very hypermetropic, it is generally defective from want of use.

When slight it may be neutralised by corresponding spectacles, but when the inequality is great, fully correcting glasses cause so much difference in the size of the images in the two eyes, that equalisation is seldom possible. But it should be attempted when there is any tendency to divergent squint, in order to encourage binocular vision.

*Effect of blindness of one eye.*—Acuteness of sight is always rather better with both eyes than with either alone; further, both eyes are necessary for the appreciation of solidity and distance. Patients often think that blindness of one eye throws 'double work' upon the other and 'weakens it.' Nearly always, however, in

such a case some other cause can be found for the asthenopia of the sound eye.

4. **Disorders of Accommodation.**—*a. Presbyopia.*—The 'amplitude' or 'range' of accommodation is expressed by the difference between the greatest distance, 'far-point,' ($r$) and the least distance, 'near-point,' ($p$) of distinct vision. Age for age, it is nearly equal in all eyes, whatever their refraction. Its natural failure with age causes presbyopia, the onset of which has been arbitrarily fixed to begin, in the emmetropic eye, at the age of 40, when the near point is at nine inches (22 cm.), and the failure generally progresses at a constant rate. Presbyopia is corrected by the convex lens, which enables the patient to read at nine inches; the strength of this lens varies inversely as the amplitude of accommodation, and at the age of 65, the near point being removed to infinity, the correcting lens is one of nine inches' focus.

Symptoms.—Presbyopia is first shown by difficulty in reading or sewing by artificial light, or in the train or carriage; defective accommodation prevents the work being held close enough to compensate for the defective light or for the shaking, and to remedy the former the candle is often placed between the eyes and the book. When more advanced the patient becomes 'long-sighted,' and has to put his book at arm's length unless he wear glasses. If the refraction is normal, distant sight is perfect. In hypermetropia, presbyopia begins at an earlier age, less accommodation being available for near vision; and in myopia it sets in later because less accommodation is needed for seeing at a given distance. Hence a low degree of myopia is an advantage. When the far point in myopia is at or within nine inches (22 cm.) presbyopia does not occur.

Diagnosis.—Presbyopia is to be distinguished from loss of accommodation due to paralysis of the ciliary nerves, and from failure due to feeble health or other causes, both of which may occur at any age. True presbyopia, however, sometimes progresses much more quickly than usual, and especially in eyes which are about to suffer from glaucoma.

Treatment.—The treatment of presbyopia consists in ordering convex glasses which enable the patient to read at nine inches or a greater distance. Most people prefer glasses which enable them to read easily at twelve or fifteen inches, and with which reading at the standard nine inches is possible only for a very short time, if at all. The smaller the quantity of accommodation remaining, the less is the range of clear vision; and if accommodation is abolished, clear sight is possible only when the object is at the focus of the glasses. Hence the increase of strength of the glasses which becomes necessary as age advances should be made gradually, that the patient may grow accustomed to the loss of range, and to the necessity for keeping his book more and more at an unvarying distance. As the book has to be placed nearer by artificial than by day-light, it is generally best to have a rather stronger pair of glasses for evening use than for the daytime. The following table, giving the strength of the glass necessary to bring the near point to nine inches (22 cm.), at various ages, serves as a useful basis for the selection of spectacles for emmetropic persons :-

| Age | Glass required to bring '$p$' to 9 in. (22 cm.) | | |
|---|---|---|---|
| 40 | 0 | | |
| 45 | + $\frac{1}{16}$ inch | = | + 1 dioptre. |
| 50 | $\frac{1}{8}$ " | = | 2 " |
| 55 | $\frac{1}{12}$ " | = | 3 " |
| 60 | $\frac{1}{6}$ " | = | 4 " |
| 65 | $\frac{1}{8}$ " | = | 4·5 " |
| 70 | 1-6½ | = | 5·5 " |

*b. Paralysis of Accommodation.*— Synon. : *Cycloplegia.*—Paralysis of the ciliary muscle occurs in paralysis of the whole third nerve. But it may occur without affection of the extrinsic muscles of the eyeball; in these cases it is generally combined with paralysis, more or less complete, of the iris (*ophthalmoplegia interna*); but it may be present as an isolated symptom, the pupils being normal, and of this the commonest example is post-diphtheritic cycloplegia. The failure of accommodation in glaucoma may be accounted for in acute cases by compression of the ciliary nerves, but in old cases is doubtless due to the atrophy of the ciliary muscle which always exists. Cycloplegia, usually with some affection of the iris, is a common result of blows on the eye; generally recoverable, it is however occasionally permanent. Lowered endurance of sight, pain, and sudden temporary failures of accommodation, are amongst the most important phenomena of sympathetic irritation.

*c. Spasm of Accommodation.* — Temporary spasmodic action of the ciliary muscle, often exceeding the necessary amount, frequently occurs in hypermetropia, with every effort to see clearly; it usually ceases at once on going into a dark room. In low myopia with irritative symptoms, the ciliary muscle often acts unnecessarily; and such spasm, when persistent, is probably one cause of further elongation of the eye. Spasm of accommodation also occurs in some functional and hysterical affections of the eyes, with other symptoms of ocular irritation. The function of accommodation is closely associated with that of convergence, although the two can be exerted separately to a limited extent ('relative accommodation'). The accommodation of one eye cannot be exercised without, and probably not in a different degree from, that of the other; nor is it proved that any part of the ciliary muscle can act independently of the rest.

*d. Micropsia.*—Definition.—Any condition of sight in which objects seem lessened in size, without diminution in the size of the retinal images. This indicates either an extreme effort of accommodation, and may be thus complained of when this function is weakened; or disease of the retina, especially syphilitic retinitis.

5. **Asthenopia.**— Asthenopia is any condition in which the eyes cannot be used for long without fatigue, pain, or other symptoms.

*Muscular asthenopia* is caused by difficulty in maintaining the convergence of the visual lines, and is commonest in myopia, though it is often seen with normal refraction, especially in youths and young adults. It causes, besides aching of the eyes, 'dancing' or 'confusion' of the print, and sometimes double vision. In slight cases, with myopia, partially neutralising glasses, which enable the book to be held at a greater distance,

will often give relief. In many cases, with or without myopia, spectacles, consisting of prisms with their bases inwards, are of great service, by lessening the convergence necessary for vision at a given distance. In high degrees, tenotomy of the external rectus is called for (*see* STRABISMUS).

*Asthenopia from defective accommodation* is also shown by inability to read for long, but there is no 'moving' or 'dancing' of the letters, nor any diplopia. The object simply becomes 'misty' or 'the sight goes' for a time, returning when the eyes are rested for a few minutes; or the eyes feel tired and hot, and ache. Headache and occasionally even vomiting may follow neglect of such symptoms. It is commonest in hypermetropia (asthenopia from excessive demand on accommodation); but is also seen in emmetropic, and even in slightly myopic, eyes, if the tone of the ciliary muscle is low (asthenopia from weakness of accommodation). Asthenopic symptoms are not common in presbyopia. The above forms of asthenopia often give rise to chronic congestion and irritation of the palpebral conjunctiva, with watering and soreness, the symptoms disappearing when glasses are worn. On the other hand an irritable and hyperæsthetic state of conjunctiva and cornea, and perhaps of the retina, with photophobia, often causes irritable weakness of the ciliary muscle, even when there is scarcely any ametropia (asthenopia from hyperæsthesia); these cases are difficult to cure.

*Retinal Asthenopia.* — Functional exhaustion of the retina or optic nerve is sometimes seen in optic neuritis, and other diseases of the optic nerve; sight being good, but becoming duller after a short period of use. It is not, on the whole, a very important diagnostic symptom.

E. NETTLESHIP.

**VIS MEDICATRIX NATURÆ** (Latin). An expression formerly much used to indicate the innate power possessed by Nature of healing or curing disease. *See* DISEASE, Treatment of; and THERAPEUTICS.

**VITILIGO** (*vitulus*, a spotted calf).–SYNON.: Leucopathia; Leucasmus; Leucoderma; 'Piebald skin'; Fr. and Ger. *Vitiligo.*

DESCRIPTION.—This disease occurs as spots, which are white, resulting from absence of pigment (*achroma*), of a circular figure, and various in number and dimensions. The pigmentless skin is pale, but otherwise healthy; and the immediately adjacent integument is more deeply coloured near the margin of the spots than on the rest of the surface. At their first appearance the spots are small; they increase by their circumference; and, by continuous growth, or by the blending of several spots, they cover a surface of greater or less extent.

DIAGNOSIS. — Vitiligo is distinguished from other forms of absence of pigment of the skin by the otherwise healthy condition of the integument. Morphœa and scleroma, the two affections for which it might be mistaken, both present manifest indications of disorganisation of the derma. Leucoderma has been confounded with the white patches of true leprosy. In this disease, however, the patches are anæsthetic, and there are constitutional symptoms which are never present in leucoderma.



TREATMENT.—Aberration of the pigment-function of the skin, and especially arrest of pigment-formation, imply feebleness of tissue, and suggest, as the indication for treatment, the strengthening of the individual, and through the individual the strengthening of the faulty organ. We may expect to derive advantage from tonic remedies, particularly from arsenic; whilst externally we must have recourse to mild stimulation, either by friction or by some stimulant local application, such as tar or sulphur, which will induce hyperæmia, a more active circulation of blood, and a more healthy nutrition of the skin.

ERASMUS WILSON.

**VITILIGOIDEA** (*vitulus*, a spotted calf). A term which has been applied by Addison and Sir William Gull to the disease now known as *xanthoma* and *xanthelasma.* *See* XANTHOMA.

**VOCAL FREMITUS.**—The sensation of vibration conveyed to the hand when applied over any part of the respiratory organs during vocalisation both in health and in disease. *See* PHYSICAL EXAMINATION.

**VOCAL RESONANCE.**—The sound heard on auscultation over certain parts of the respiratory organs, during vocalization, both in health and in certain forms of disease. *See* PHYSICAL EXAMINATION.

**VOICE, Disorders of.** — SYNON.: Fr. *Troubles de la Voix*; Ger. *Stöhrungen der Stimme.*

INTRODUCTION.—Voice is the sound produced in the larynx by air driven from the lungs through the rima glottidis, modified in accordance with acoustic laws in the upper air-passages. Vocalization is a function needing for its perfect production a healthy condition of the respiratory muscles, of the lungs, trachea, and larynx, of the pharyngeal, oral, and nasal cavities, and of the nerves and nervous centres on which these parts depend for their isolated or co-ordinated muscular movements and their normal sensitiveness. For the production of the simplest vocal tone the cords must be free to approximate within a line of one another, while the co-ordinated action of about one hundred muscles is required, to regulate their tension and that of the walls of the air-passages, to modify the form of the latter, and to produce the current of air.

Acoustically the organ of the voice must be regarded as a combined reed and pipe; and for the production of a perfect note, it is necessary that the pipe should be in perfect unison with the reed. This unison depends not only on the shape of the various cavities, but on the relative rigidity or flexibility, and the tension of their walls; every variation in the number, size, or form of vibrations of the vocal cords, effected by the intrinsic laryngeal muscles, calling for similar modifications of the shape, size, and tension of the consonating cavities.

The word 'voice,' when used alone, always implies the presence of a musical tone (periodic vibrations), but sound sufficient for every purpose of speech and articulation may be produced

without a musical tone. This is the *whispering voice*, caused by the rustling of air through the half-open rima and relaxed air-passages. To this condition—absence of musical tone in the voice—the term *aphonia* is applied, and it must be distinguished from the actual inability to produce sound, which we see after tracheotomy, where in the effort to speak, the organs of articulation and sound are seen to move, but neither noise nor musical sound is heard.

Pathological Relations.—The morbid modifications of vocalisation are necessarily numerous, in proportion to its complexity and the number of parts concerned in its production; but it may be generally stated that, in consequence of disease or perverted action in any of these parts, the voice may be altered either (1) in *loudness* or *force* (size of sound-waves); (2) in *pitch*, or relative height of its note (rate of sound-waves); or (3) in *quality* (shape of sound-waves). And even before there is obvious change in any of these respects, the power of passing rapidly and easily from one pitch to another, constituting melody, may be seriously impaired. The morbid alterations of the voice in these several directions will now be discussed; and brief reference will also be made to (4) *stammering of the vocal cords*; (5) *aphonia*, and (6) the *vocal signs in the chest*.

1. **Changes in Force.**—The voice is weakened in every disease which lowers the general muscular tone, or depresses the nervous system. The gradual change is well seen in phthisis without laryngeal affection, where at last even the effort to approximate the vocal cords is too much for the patient, and he speaks in only a whispering voice. In the same way painful affections of any of the parts enumerated above, interfering with muscular effort, weaken the voice. Speaking generally, mere diminished loudness of the voice depends usually on general rather than on laryngeal disease.

2. **Alterations in Pitch.**—The note of ordinary speech may be habitually raised or lowered, and the range of the singing voice may be seriously limited. The note of the voice depends primarily on the rate of vibration of the vocal cords; and this is the mean result of the tension, the length, the density, and the thickness of the cords at the time the tone is produced, and the force of the current of air sent through the rima. Structural changes, therefore, in any one of these respects, will alter the pitch of the voice; and change in the ordinary vocal note is usually to be referred either to an affection of the tensor muscles of the larynx, to structural change in the mucous membrane covering the cords, or in the cords themselves. Lowering of the pitch of the speaking and the range of the singing voice occurs with any condition which relaxes the mucous membrane, weakens the nervous and muscular system, or makes the tense condition of the vocal cords and the consonating cavities painful. Paralysis of the intrinsic muscles, which admit of the approach of the vocal cords but interfere with their tension and density, affects the pitch as well as the quality, the voice being rough and deep in the paresis of the tensors (superior laryngeal nerve) and of the abductors of the larynx (recurrent nerve)

The imperceptible transition from the chest to the falsetto voice, in which, whilst the condition of the vocal cords is suddenly altered, the form of the larynx, trachea, and other consonating cavities is simultaneously changed, requires a perfect control of the vocal organs, attained only by accomplished vocalists. On this change of register occurring involuntarily, the cracked voice in speaking is the result; and being referable to imperfect co-ordination, it is common in males about puberty, when the form of the larynx is changing, or may even persist occasionally throughout life. A curious affection of the pitch of the voice, in speaking, when two tones of different pitch are simultaneously produced (diplophonia), appears to depend on the division of the rima into an anterior and posterior opening, either by small morbid growths, strings of mucus, or irregular action of the muscles.

3. **Change of Quality.**—The quality of the voice is affected by every alteration either in the cords or in the consonating cavities, the purity and character of the tone being liable to numerous modifications, until, the musical note disappearing entirely, mere noise (aphonia or whispering) remains.

*Hoarseness.*—Hoarseness and huskiness, a combination of whispering and a badly sustained musical note, imply imperfect and irregular approximation of the vocal cords. Over-exertion of the voice, catarrh, &c., produce it temporarily, giving rise to irregular tension of the cords, to shreds of mucus, and to swellings of the mucous lining, which interfere with their regular approximation; while all changes short of those which absolutely prevent the closure of the cords, may cause it as a persistent phenomenon. To the larynx itself we look therefore for the source of persistent hoarseness. Amongst the pathological conditions of which hoarseness is a symptom are chronic swelling of the mucous membrane, general or local, interfering with the closure of the rima; exudation or ulceration, and therefore inflammation, simple, specific, or diphtheritic; neoplasms; old cicatricial contractions; paralysis of the adductors of one cord, which necessitates the crossing of the normal cord beyond the median line to meet its fellow, as well as other forms of paralysis; fixing of one vocal cord by anchylosis of the crico-arytænoid joint. The paralysis may of course depend on disease of the nervous centres, on the nerves themselves, or on pressure by intra-thoracic or other tumours on the nerve-trunks. Hoarseness, short of aphonia, is also a symptom of general exhaustion, as seen in phthisis and cholera.

The character of the speaking voice is also altered by any change in the resonating cavities. Thus the voice is said to have a *nasal twang* when the upper pharyngeal and nasal cavities are not completely shut off in vocalisation; while, on the other hand, obstruction in the nares, preventing the passage of the air through them and the formation of the nasal consonant sounds, is popularly, though wrongly, called 'speaking through the nose.' If the obstruction be situated in front of the nares, the sounds can be produced, but not continued; if the ob-

struction be in the upper pharynx, or at the back of the nares, they cannot be produced at all. When with obstruction in the nares there is swelling of the pharynx and the soft palate, the voice assumes the character so familiar in cases of quinsy.

Changes in the walls of the chest and the pectoral cavities also alter the character of the voice, the hollow voice of the emaciated phthisical patient illustrating this. The phonation, on inspiration, of spasmodic croup and of child-crowing or laryngismus stridulus must be referred to as the result of spasm of the vocal cords, though this involuntary function hardly comes within the definition of voice, which term should be limited to sound produced in the vocal organs to establish communication between living beings.

**4. Stammering of the Vocal Cords.**—Spasm and defective co-ordination are the source of this peculiar affection of the voice, in which there are sudden interruptions of the voice without affection of the articulation (Prosser James).

**5. Aphonia.**—The various modifications of voice hitherto considered only occur where the vocal chords are free to meet more or less perfectly. Aphonia or complete loss of the musical tone, occurs where the cords cannot meet. Amongst the conditions which will prevent the approximation of the cords and cause aphonia are paralyis or paresis of the adductor muscles, on whatever cause it may depend; fixation of the cords by cicatricial contractions, or by anchylosis of the crico-arytænoid joints; their destruction by ulceration; any painful affection which makes the patient involuntarily rest them; or coating with false membrane. But by far the most frequent cause of this aphonia is the abrogation or perversion of the will, occurring in the morbid mental condition of hysteria or other nervous disease; perfect power of phonation existing, but the patient, for months or years, declining to exercise the power, or to make the necessary effort. The intimate relations of the voice to the higher functions of the brain would lead us to expect that it would be influenced by the emotions. Thus we have a person hoarse with rage, speechless with terror, &c., and the origin of these cases of nervous aphonia is frequently some sudden emotion, causing loss of control over the voice. Von Ziemssen believes that, even where the vocal cords cannot meet, by a great effort the patient may produce a hoarse, monotonous tone by vicarious vibrations of the ventricular bands.

Treatment. — The local treatment of the various diseases of the respiratory organs which give rise to disorders of the voice, is fully discussed in the several articles on these subjects (*see* Larynx, Diseases of; Stammering; Throat Diseases of; Trachea, Diseases of). The *general* treatment will depend upon the constitutional state. *See* Hysteria; and Phthisis.

**6. Vocal Signs in Chest.**—Some consideration must be given to the changes in the voice which are audible when the stethoscope is applied to the chest. Normally the vibrations of the vocal cords are conveyed to the ear applied to the chest by propagation along the contained air, the rigid portions of the air-chambers, and the thoracic walls, the voice being heard as a feeble, buzzing, musical tone. This sound is weakened when the original tone is weakened by laryngeal disease; when fluid is interposed between the lung and the chest-wall, pus and less homogeneous fluids forming a more complete obstacle than simple serum; and when the bronchial tubes are obstructed by secretions or other cause, preventing the conveyance of the vibrations. The sound may, on the contrary, be exaggerated, giving rise to the phenomena of *bronchophony*, *amphoric* voice, and *ægophony*. Bronchophony is simple increase in the vocal resonance, and is heard under the same conditions which give rise to bronchial breathing, that is, over lung consolidated by exudation or condensed by compression, and over cavities with solid walls. The term *pectoriloquy* is commonly applied to excessive bronchophony, but Dr. Bristowe would limit it to the rare instances in which not only the laryngeal tone, but the articulate sounds produced in the mouth, are conveyed back to the chest, and thence through the chest-wall to the ear. Amphoric voice (*amphorophony*) is the term applied where the vocal resonance is not only increased, but acquires a metallic ring, from the addition of a consonant tone acquired in large cavities of the lungs. This is sometimes heard in a marked degree in pneumothorax, though in other cases of the same disease the vocal resonance may be absent or greatly diminished.

*Œgophony* is heard where there is a thin layer of fluid between the ear and the lung, as in small effusions or at the margin of larger effusions. It is a bleating, tremulous tone, supposed by Bristowe to result from the interposed fluid preventing the fundamental note-vibrations from reaching the ear, while it permits the finer and closer vibrations of harmonics to penetrate. *See* Physical Examination.

Thomas J. Walker.



**VOLITION, Disorders of.**—Synon.: Fr. *Troubles de la Volition*; Ger. *Stöhrungen des Wollens.*

Various lesions of the cortex of the hemispheres may arrest or interfere with volition at its source, and that not solely when the lesions occur in the so-called 'motor regions.' If we assume that these particular regions of the cortex are the parts whence motor incitations pass off on their way to lower centres, it is only necessary to bear in mind, on the one hand, the continuity of molecular actions through definite tracts of the brain-tissue, and, on the other hand, the frequency with which volitions are immediately aroused by some antecedent sensorial processes, to understand that damages to certain sensorial centres or internuncial fibres within the hemispheres are almost as liable to interfere with certain classes of volition as are those which occur in the so-called motor region itself. After all, volition is only, and must always be, a result of sense and intellect in action. Its manifestations may, therefore, be *impeded* either by disease at the sources in which it originates, or in one or other portion of the tracks along which its initial incitations are conducted on their way to motor centres, and

thence to the muscles whose activity is to be awakened.

In other cases, with *exalted* activity of some of the centres in which volitional incitations arise, we may have, especially in acute mania and violent delirium, the birth of impulses which are absolutely 'uncontrollable.' Where these conditions are absent, however, and whether the persons in question have been accustomed or not to exhibit evidences of a weak or defective *morale*, it is most important not to confound 'uncontrolled' with 'uncontrollable' impulses. This is the kind of question which becomes all-important in many criminal cases—cases, that is, in which persons are under trial for murder, manslaughter, or theft, and in which 'unsoundness of mind' is pleaded in extenuation. *See* CRIMINAL IRRESPONSIBILITY.

On the other hand, a *dormant* or *sluggish* volition is met with in some other forms of insanity, as well as in hysteria, the subjects of which cannot or do not rouse themselves to perform the most ordinary actions. They may from this cause be speechless, or they may experience the most extreme difficulty in arriving at any decision even in reference to the most trivial circumstances. *See* INSANITY, Varieties of.

Again, so-called defects of memory and *defects* of volition are sometimes inextricably involved in many forms of brain-disease; so that the same disability may, from one point of view, be regarded as an instance of defective memory of a special kind, or from another as a peculiar and limited interference with volition. *See* MEMORY, Disorders of.

In very many cases of apparent *loss* of volitional power—that is, in multitudes of instances of complete paralysis of a part or of a muscle—where the causal lesion is situated in regions below the cortex cerebri (*e.g.*, in lower motor centres, cerebral or spinal, or in motor nerves), there is not an arrest of volition, but rather an impediment to the actuation of volitions (*see* PARALYSIS, MOTOR). But whether volition itself is nipped in the bud, or whether, though really existent, it is rendered abortive, the patient is practically reduced to the same condition—since his power of responding to sense or thought through particular muscles may be equally interfered with in either case. *See* SPEECH, Disorders of.

H. CHARLTON BASTIAN.

**VOLVULUS** (*volvo*, I roll).—A synonym for intussusception. *See* INTESTINAL OBSTRUCTION.

**VOMICA** (*vomo*, I vomit, I cast up).—SYNON.: Fr. *Vomique*; Ger. *Lungengeschwür*.

DEFINITION.—A term applicable to all ulcerative spaces in the lung in open communication with bronchi.

ÆTIOLOGY.—The multifarious agencies leading to excavation may be grouped as follows:—

I. *Destructive processes*: (*a*) injury, (*b*) gangrene.

II. *Suppurative processes*: (*c*) acute pulmonary abscess; (*d*) suppuration around inhaled foreign bodies; (*e*) suppuration around new formations (including hydatids); (*f*) extension of abscesses, (1) from the pleural cavity; (2) from the abdominal cavity, or from the abdominal organs; and (3) from the mediastina.

III. *Degenerative processes*: (*g*) ulceration of cancerous or sarcomatous growths; (*h*) ulceration of syphilomas; (*i*) ulceration of tubercle; (*j*) softening of chronic inflammatory consolidations (catarrhal pneumonia and caseous pneumonia); (*k*) softening of intensely congested or œdematous tissues (a condition sometimes due to pressure from aneurisms or tumours); (*l*) liquefaction of ancient deposits—caseous, pultaceous or hæmorrhagic (hæmorrhagic nodules—Dr. R. E. Thompson).

Phthisis being the cause of the immense majority of pulmonary excavations, the ensuing remarks will be chiefly devoted to phthisical vomicæ.

ANATOMICAL CHARACTERS.—*Varieties in size and in shape.*—Vomicæ may be sub-lobular (then aptly termed *cavernules*), lobular, lobar, or they may involve the whole of one lung. Tubercular deposits, being usually smaller than catarrhal infiltrations, lead to smaller cavities. Catarrhal inflammation gives rise to the lobular, caseous pneumonia to the lobar excavations, and to the wholesale destruction of a lung. Œdematous forms of catarrhal pneumonia often undergo rapid and extensive softening; the interlobular septa escaping liquefaction, whilst the parenchyma is carried away. This dissecting excavation forms the counterpart of caseous pneumonia, where the tissues are destroyed *en masse*, with the sole exception of the larger branches of the pulmonary artery.

When strictly confined to a lobule, the excavation is roughly spherical. If many lobules should be simultaneously involved, their coalescence may give rise to irregular vomicæ; but the ultimate shape of cavities chiefly depends upon the peculiarities of the bronchial distribution to the district affected.

Vomicæ are frequently trabeculated. Trabeculæ (clearly to be distinguished from denuded branches of the pulmonary artery) invariably consist of blood-vessels and of collapsed or indurated alveolar substance. They are the remains of intervals of spongy tissue, originally separating distinct cavities. Their ulceration and partial absorption often give rise to a knobbed condition of the internal surface of cavities.

During the period of formation and of extension the walls of cavities are rough and ulcerous. But the completed cavity becomes surrounded by a fibro-vascular zone, the outer surface of which is continuous with the pulmonary tissue, whilst its innermost stratum constitutes, during the active stages, a pyogenic layer, and subsequently an exfoliating false membrane. Vomicæ thus invested are said to be *encapsulated.*

Important differences are noticeable in the condition of tissues around cavities. The capsule of a vomica may be immediately surrounded by alveolar substance, the expansion of which may exert a favourable amount of pressure upon it; or it may be continuous with inflamed and thickened tissue, or with tubercular infiltrations. In extreme cases the lung is to such an extent invaded by the fibrous growth from an adherent pleura, that the vomicæ present the appearance

of having been formed at the expense of the fibrous tissue itself ('fibroid phthisis').

*Situations.*—No appreciable difference exists between the liability to excavation of the right and that of the left lung. Primary excavation almost invariably attacks the upper part of the upper lobe; its most common seat is the central part of the subclavicular region, not the apex proper; it may, however, extend to the very summit of the lung, or involve the greater part of the upper lobe. Phthisical destruction very rarely has its starting-point in the middle or in the lower third of the lung. The base of the lung, on the other hand, is the most common seat of those cavities which are not due to phthisis (for example, abscesses by extension, gangrene, and syphilitic ulceration).

The common form of phthisis, originally attacking the apex, implicates, almost without exception, the mid-dorsal region secondarily; this the writer has shown to be due to the transmission of irritating matter along the bronchus supplying that district. Similarly the base becomes affected in the latest stages of excavating disease, if life should be sufficiently prolonged.

*Bronchi in relation to vomicæ.*—Cavities not smaller than a lobule inevitably open into a bronchus. The communication may be temporarily obliterated, or it may in rare instances become permanently sealed. Most cavities exceeding the size of a single lobule intercept more than one bronchus; and the air-tubes ulcerate within them at an early period of the softening. Thus two sets of bronchial orifices may be recognised in vomicæ, the proximal and the distal, forming as many small islands of mucous membrane on the internal surface of cavities.

*Blood-vessels in relation to vomicæ.*—Trabeculæ always contain either patent or obliterated vascular branches. More resistant than all other structures, these vessels may become completely exposed and finally eroded. But aneurism or erosion more commonly has its seat in those branches of the pulmonary artery which ramify in the thickness of the cavity wall, a fact readily explained by the persistence of circulation within these vessels, by their inability to retract, by the uneven support which their coats receive at different points of their circumference, and by their diseased condition. Fatal hæmorrhage may occur without any warning from the erosions or from the aneurisms. More habitually premonitory bleeding of limited extent recurs at short intervals prior to the fatal rupture. Pulmonary aneurisms sometimes undergo spontaneous cure when their growth is limited by the small size of the cavity which contains them; or the pressure of the extravasated blood may effect the same result subsequently to their rupture. It is almost the rule for aneurisms to occur simultaneously at different parts of the same lung.

*Extension of vomicæ.*—Cavities increase in size by the gradual necrosis of their inner wall; by the fusion of adjacent excavations; and by their encroachment upon fresh bronchial territories, which become the seat of similar ulceration.

*Retrocession of vomicæ.*—The *contraction* of cavities is essentially due to the shrinking of their capsule. This force is assisted in some cases by the expansion of the neighbouring spongy tissue, or even of the hypertrophied healthy lung; in other cases by the constricting pressure from a thick zone of fibrous tissue; indirectly also by the falling-in of the ribs, by the rise of the diaphragm, and by the abundant growth of new fibrous tissue in the thickness of the pleural adhesions.

The *retraction* towards the root of the lung, which is so commonly observed in chronic vomicæ, is partly due to the inflammatory thickening and shortening of the bronchus; it is often opposed by adhesions of the corresponding pulmonary surface to the chest-wall.

In their contracted state vomicæ may remain dormant for years. Final obliteration is rarely attained, chiefly owing to their deficient granulating power, and to the superficial necrosis of their opposed surfaces, both these conditions being the outcome of imperfect drainage.

Consequences of Excavation.—Amongst the *general* consequences of pulmonary excavation are loss of breathing surface; exhausting suppuration, often leading to lardaceous degeneration of the organs; and tuberculosis. The chief *local* consequences are secondary deposits (pneumonic or tubercular) in the healthy portions of the lungs, as a result of the inhalation of the secretion of cavities, and of other products. Lastly, as the result of the contraction of cavities, we meet with local shrinking of the lung and collateral emphysema; various involutions of the pulmonary surface; various deformities of the thorax, &c.

Among the fatal accidents incidental to excavation rupture of aneurisms has already been referred to. Perforation of the lung, leading to pneumothorax, is a danger special to the more insidious varieties, in which the softening is rapid, whilst the inflammation is of low type and unaccompanied with the usual tissue-reaction.

Diagnosis.—The ordinary methods of physical examination, by which the presence of cavities may be detected, are described in other articles (*see* Phthisis; and Physical Examination). A few points only claim specially to be noticed. Cavernous sounds are seldom given by cavities smaller than an ordinary filbert, probably owing to the small size of their bronchus. Cavities even of larger size are not infrequently completely masked by the interposition of spongy tissue; this is more especially the case in the tubercular forms. In the opposite condition of cirrhosis, cavernous sounds may be absent or very feeble, in consequence of deficient inspiratory movements. Lastly, the accidental blocking of a bronchus may suspend for a time all auscultatory evidence of excavation. The distance of the vomica from the surface may be roughly estimated from the intensity of the sounds; its degree of fulness from their liquid character; the smoothness of its walls from their amphoric nature; its compressibility by surrounding spongy substance, and its elastic resiliency, from the suction-sound sometimes heard during the respiratory pause following cough, aptly termed by Dr. Mitchell Bruce the *indiarubber-ball sound*.

A determination of the extent of the vomica can generally be attained by careful investigation. Sometimes, however, cavernous sounds are

propagated beyond the excavated region by consolidation. Occasionally they are re-echoed at a symmetrical point in the sound lung, especially at the base. Phantom-caverns of this nature may be suspected whenever absolute identity in the position and in the auscultatory quality of the sounds on either side coincides with great disparity in percussion-resonance and in vocal fremitus.

Valuable information is derivable from the *sputa*. Abundant purulent discharge always indicates an active condition; if mixed with much mucus, it points to a co-existing bronchial catarrh; if shreddy and fœtid, to a cavity of some magnitude, imperfectly drained. The intimate admixture of blood indicates a congested state of the membrane. From the presence of abundant, well-preserved, elastic elements it is possible to diagnose the moister forms of necrosis; caseous lumps argue the existence of caseous pneumonia; the expectoration of calcareous particles shows that excavation is progressing at the expense of more or less fibrosed tissue resulting from former disease; and, according to Koch, the presence of bacilli staining deeply with methylene-blue and not decolorised by vesuvin, is a test for tubercle. Lastly the cessation of all secretion is indicative of a perfect quiescence of the vomica.

Prognosis.—In cavities not due to phthisis, the absence of the constitutional element greatly favours recovery; and their progress is mainly governed by the nature of their cause, by their size, by their situation, and by other influences enumerated below. Where healing is much delayed in such cases, the eventual development of phthisis is rendered probable.

The prognosis of phthisical vomicæ is intimately bound up with the prognosis of phthisis, a subject too wide for discussion here, but fully treated in the article Phthisis, and in Dr. James Pollock's work on *The Elements of Prognosis in Consumption*. Most unfavourable are the vomicæ due to a breaking up of tuberculo-pneumonic deposits. Vomicæ originating in pure tubercle, although they may contract, seldom heal. Where hæmorrhage occurring in a lung previously quite free from disease, subsequently leads to excavation, the closure of the cavity is encouraged by the contraction which characterises these cases. But the pneumonic class, which comprises the most rapidly fatal cases of excavation, also supplies the most striking instances of recovery. There exists a large clinical group in which the affection is limited to a small portion of one lung, and in which the disease is rather local than constitutional. On careful analysis of these favourable cases, the chief elements of their fortunate termination will be found to be the following:—1st, unilateral character of the affection; 2nd, its small extent; 3rd, comparatively rapid occurrence of softening; 4th, complete removal of the whole consolidation; 5th, absence of close adhesions to the thoracic parietes; and 6th, facilities afforded for collateral expansion.

Treatment.—The ideal treatment of cavities would have for its objects:—(1) to restore healthy action to their surface; (2) to prevent a stagnation of their secretions; and (3) to encourage their contraction.

For the fulfilment of these indications various *surgical* measures have been practised:—1st, free incision and injections (Barry, 1727); 2nd, paracentesis (Ramadge, 1836); 3rd, free incision and drainage (Hastings and Storks, 1845); 4th, paracentesis and injections (Mosler, 1873); and 5th, needle-injections of medicated fluids (Pepper, 1874).

Much may yet be expected of modern surgery in the treatment of excavating disease. Hitherto, however, there exists but meagre evidence to show that any good has resulted from surgical interference, and the range within which such interference is justifiable is very limited.

The *ordinary* methods of treatment comprise, in addition to the use of constitutional remedies:—

1st. Treatment by *inhalation* of medicated spray, of medicated vapours, of air charged with the natural exhalations from the sea, from pine-forests, &c. *See* Inhalation; and Climate, Treatment of Disease by.

2nd. Treatment by *posture*, sometimes facilitating, as it does, the drainage of cavities.

3rd. Treatment directed to the enlargement of the thorax and to the *expansion* of the lungs, such as passive exercise of the thoracic muscles, inhalation of rarefied air, and especially residence at high altitudes. Wm. Ewart.

**VOMIT: Examination of Vomited Matters.**—Vomited matters may consist either of substances present in the stomach when vomiting begins, or of substances entering it during the process. Those present in the stomach *when vomiting begins* include articles of food and drink, or other ingesta, more or less altered by digestion or fermentation; saliva, epithelium, mucus, pus, or blood from the nasal passages, mouth, pharynx, or œsophagus; fluid or mucus secreted by the stomach itself, epithelium-cells, casts of tubules, or even shreds of gastric mucous membrane, blood more or less altered proceeding from the walls of the stomach, cells or small pieces from morbid growths, and occasionally, as mentioned by Dr. Quain, the whole of a pedunculated morbid growth; fungi, as torulæ and sarcinæ; parasitic worms; bile; pancreatic juice; pus from abscess of the stomach or liver; fæculent matter from the intestine. *During vomiting* much saliva may be swallowed; and bile, pancreatic juice, pus or fæces, not originally present in the stomach, may be pressed into it by the straining. Effusion of blood into its cavity may also be caused by the efforts of retching.

**Method of Examination.**—In examining the vomited matters it is advisable, first, to separate the larger pieces of undigested food by filtering the vomit through canvas or muslin.

The *solid residue* may be investigated by washing the larger pieces and tearing them up, or making sections of them, so that their nature may be ascertained. Partially digested curd is sometimes not very easy to recognise. When a large quantity of milk has been drunk at one time, the curd which it forms in the stomach may, when vomited, have the appearance of a piece of thick dense grey felt.

The *filtrate* should be put into a conical glass and allowed to settle. The reaction of the fluid

is to be ascertained by litmus paper. The presence of free hydrochloric acid may be tested for, by putting one drop into a watch-glass containing a one per cent. solution of tropeolin, the yellow colour of which is converted into a wine red if hydrochloric acid be present. The total acidity may be estimated by filtering and adding a standard solution of caustic soda or potash to a measured quantity of the filtrate, until it is neutralised. For the methods of examining more particularly the various acids — lactic, acetic, butyric, &c.—and other volatile substances, text books of chemistry must be consulted.

To ascertain the presence of pepsin in the vomit we add to it its own bulk of dilute hydrochloric acid (ten minims of dilute hydrochloric acid, B.P., to an ounce of water) and a flock of fibrin or a piece of hard-boiled white of egg; let it stand for several hours in a warm place; and then see whether or not the fibrin or albumen is dissolved.

To test for trypsin, we proceed in the same manner, but use the vomit without the addition of acid; and if it be already acid, neutralize it with bi-carbonate of soda.

To test the vomit for peptone, we must put some of it into a small dialyzer, and let it stand for some hours. We then add to the water in which the dialyzer has stood, solution of corrosive sublimate, which gives a precipitate with peptones; or some liquor potassæ and a drop of very dilute sulphate of copper solution, which gives a precipitate dissolving on shaking, and forming a red solution, changing to purple when more copper is added.

Bile is tested for in the filtered liquid by Gmelin's and Pettenkofer's tests.

For blood in the vomit *see* Hæmatemesis.

If the vomited matter be too thick to allow the sediment to subside, a little of it should be mixed with some distilled water and allowed to settle. A drop of the sediment is then to be examined microscopically; and the examination is facilitated by adding to one specimen a drop of iodine solution, and to another a drop of aniline red or blue solution. The substances most likely to occur are partially digested fibres of voluntary or involuntary muscle, elastic fibres, connective-tissue bundles from meat in the food, spiral fibres and green chlorophyll granules from vegetables, starch-granules — stained blue by iodine, torulæ or sarcinæ, blood-corpuscles, leucocytes, scaly epithelium from the mouth, cylindrical epithelium from the stomach, and casts of the gastric follicles—sometimes fibrinous, sometimes composed of cells and granules, which take up the aniline colour, and are thus rendered more easily visible.

**Clinical and Pathological Indications.**—If the vomited food be unchanged, or but little changed, it indicates either that the vomiting has occurred soon after a meal, or that the secretion of gastric juice is deficient either in quantity or quality. The food is usually comparatively little changed in nervous vomiting, or in cancer of the cardiac extremity of the stomach. In vomiting from cancer of the pylorus, or duodenal ulceration, the food is much more digested, as it remains much longer in the stomach. If undigested food be vomited some hours after a meal, the vomit should be examined in order to ascertain whether pepsin or acid is deficient. Complete absence of hydrochloric acid has been observed in cases of amyloid degeneration of the stomach, and a deficiency of acid has been found experimentally in acute anæmic and febrile conditions. Abnormal acidity from fermentation of saccharine or farinaceous articles of food, and the consequent production of acetic, lactic, and butyric acids, occurs in chronic catarrhal conditions. In some cases of gastric catarrh starch appears to undergo a mucous fermentation, and large quantities of glairy material are formed. When fermentation has gone on to a great extent, the vomit may have a yeasty look, and should then be examined for sarcinæ and torulæ. *See* Sarcinæ; and Stomach, Dilatation of.

Sometimes large quantities of a watery fluid are vomited. This is occasionally alkaline or neutral, contains potassium sulphocyanide, and digests starch. It consists of saliva, which has been secreted abundantly on account of reflex irritation arising from the stomach, and swallowed. At other times it is strongly acid, and appears to be secreted by the stomach. Sometimes the vomit appears to be a mixture of both of these fluids. Such vomiting may occur from nervous disturbance of the stomach, but may be symptomatic also of catarrh, ulcer, or cancer. Mucus in the vomit indicates catarrh of the gastric mucous membrane; and the more acute the inflammation, the more leucocytes occur in the mucus. Bile may be vomited pure, in the form of a tasteless golden-yellow substance like yolk of egg, from the action of poisons, but this rarely happens. Vomiting of bile, more or less green and diluted, or mixed with digestive secretions or food, occurs as a symptom in congestion of the liver; but it may take place in all kinds of vomiting, whatever its cause. Large quantities of bile, mixed with the secretions from the mouth and stomach, and forming a grass-green liquid (*vomitus æruginosus*), may be vomited in peritonitis and cerebral affections. The writer has also observed this character of vomit in opium-eaters. Constant absence of bile when vomiting is persistent, points to pyloric stenosis. Pus may get into vomit from the bursting of an abscess in the mouth or tonsils; it sometimes, though rarely, may arise from an abscess in the walls of the stomach; but it is more likely to come from abscess of the liver. Blood vomited in large quantity, and of a bright red colour, usually indicates ulceration of the stomach or cirrhosis of the liver. More or less altered, and in smaller quantity, it occurs in the diseases just mentioned, and also in cancer and yellow fever (*see* Black Vomit; and Yellow Fever). It may also be present in hysterical persons who have swallowed blood, obtained from external sources, or by sucking hollow teeth. Cancer-cells in the vomited matters are diagnostic of the presence of that disease. T. Lauder Brunton.

**VOMITING** (Lat. *vomo*).—Synon.: Fr. *Vomissement*; Ger. *Erbrechen*.

Definition.—Forcible expulsion of the contents of the stomach through the œsophagus.

Ætiology and Pathology.—The contents of

the stomach are expelled from it by the mechanical pressure brought to bear upon it by the diaphragm and abdominal parietes, which contract simultaneously. When these muscles contract, if the cardiac orifice of the stomach remains closed, an ineffectual effort at vomiting, or retching, occurs; but if the cardiac orifice dilate, the gastric contents are expelled. When the diaphragm and abdominal muscles are paralysed, vomiting is impossible, though the stomach may be in active movement. The stomach is not necessary to vomiting, which will occur when that organ is excised, and a simple bladder tied in its place; but when the stomach is present, mere pressure upon it by the diaphragm and abdominal muscles, as in coughing, does not expel its contents. The cardiac orifice is relaxed by means of the longitudinal fibres, which run along the under end of the œsophagus below the diaphragm, and then radiate completely over the stomach. When they contract they dilate the cardiac orifice, and at the same time aid the evacuation of the stomach by drawing the whole viscus towards the diaphragm. In the act of vomiting, then, the simultaneous contraction of three sets of muscles is required:—(1) of the diaphragm, (2) of the abdominal wall, and (3) of the muscular fibres just mentioned in the stomach itself. The movements of these muscles are co-ordinated by a nervous centre, situated in the floor of the fourth ventricle in the medulla oblongata. This centre is closely associated with, though of course not identical with, the respiratory centre. The motor impulses from these centres are sent to the abdominal muscles, diaphragm, stomach, and œsophagus, by the intercostal, phrenic, and pneumogastric nerves respectively. The reasons for supposing that the nervous centre for vomiting is closely associated with the respiratory centre, are that the movements of vomiting are modified respiratory movements, that emetics excite the respiratory centre, and that their action is usually preceded by increased respiratory movement, while depression of the activity of the respiratory centre stops vomiting. When the blood is rendered very arterial by excessive respiration, a condition of apnœa, in which no need of respiration is felt, and no respiratory movements are made, is produced; but if emetics are then injected into the veins, respiration not only becomes more frequent, but apnœa can no longer be induced, unless the activity of the respiratory centre be lowered by narcotics.

The vomiting centre is usually excited to action by irritation of certain *afferent nerves*. These may either act directly upon it, or through the medium of the brain. The nerves of special sense act through the brain. The sight of a disgusting object, a disagreeable stench, or an unpleasant taste, may excite vomiting, and it may also be produced by the simple thought of such subjects. Blows on the head, or inflammation of the brain or its membranes, also excite vomiting. According to Budge, the cerebral centres for the movements of the stomach are in the right corpus striatum, and especially in the right optic thalamus. When these parts are irritated the stomach moves. Irritation of the corresponding parts on the left side of the brain does not affect the stomach. Vomiting occurs in certain cerebral conditions, either affecting the brain itself or its membranes, such as cancer or tubercle of the brain, apoplexy, cerebellar hæmorrhage, softening of the cerebral substance, sometimes encephalitis, poisoning by narcotics, melancholia, profuse næmorrhage, or tubercular meningitis. It is also one of the symptoms of Menière's disease of the semi-circular canals. It also occurs in various diseases, in which, however, it is difficult to say whether the vomiting be due to direct affection of the brain itself, or to reflex action upon it from other organs. Such diseases are typhus, plague, yellow fever, cholera, and the cold stage of ague. Very painful impressions on sensory nerves throughout the body may excite vomiting. This is seen in cases of loose cartilages in the knee, in dislocation of a joint, or in a painful wound or operation. Here, also, it is uncertain whether the vomiting be produced through a direct connection of sensory nerves with the vomiting centre, or whether the irritation acts indirectly through the cerebrum.

Certain afferent nerves appear to have a more direct connection with the vomiting centre than others, and these require special consideration:—

(1) *Branches of the glosso-pharyngeal nerve to the soft palate, the root of the tongue, and the pharynx.*—These parts have a very close connection with the vomiting centre, and tickling them with the finger or with a feather is one of the readiest means of inducing vomiting.

We find vomiting occurring in inflammation of the soft palate or tonsils, and also of the pharynx, especially in children.

(2) *The nerves of the stomach.*—The sensory nerves of the stomach are chiefly branches of the vagi, but they belong partly also to the sympathetic system. When the vagi are cut vomiting becomes difficult, but efforts at retching occur, and vomiting will even take place from the action of emetics after section of the vagi. It is therefore evident that irritation of the stomach produces vomiting reflexly through other nerves than the vagi. Vomiting may occur from irritant substances in the stomach, whether introduced into the stomach, or formed within it; from irritation within the stomach, from an inflamed or irritated condition of its walls; or from mechanical pressure, from without or from within. Thus it may occur from the presence of undigested food, from irritating substances produced by imperfect digestion, or from irritant poisons within the stomach. It may be due to catarrh or congestion of the mucous membrane itself, to softening of the mucous membrane, or to cancer in the gastric wall. It may be produced by extreme distension of the stomach, by gas, liquids, or solids; by compression of a part of it within the body, as in hernia of the stomach; or by the pressure of a tumour upon it. It may be caused by violent compression externally with the hands; by the pressure of a too tightly laced corset; by the pressure against the abdominal walls of hard tools or benches in certain trades. It frequently occurs in cough, especially the cough of phthisis; but here it is probable that the vomiting is due partly to the violent compression between the diaphragm and abdominal walls, and partly to the congestion of the vessels which the continued

interruption of the circulation during the fit of coughing brings on.

(3) *The nerves of the liver and gall-ducts.*—These consist chiefly of branches of the vagus and sympathetic. From their irritation vomiting occurs in hepatitis, or during the passage of a biliary calculus. It is from irritation of these branches, also, that vomiting may occur in pleurisy of the right side, the congestion of the pleura on the upper surface of the diaphragm having led to congestive changes in the liver.

(4) *Intestinal nerves.*—Ligature of the intestine in animals produces vomiting, which is arrested by dividing the nerves passing from the ligatured parts. In man it is the almost invariable accompaniment of strangulated hernia or intussusception, and it may even occur in obstruction of the bowel by fæcal matters in cases of obstinate constipation. It also takes place in peritonitis from irritation of these nerves.

(5) *The renal nerves.*—From irritation of these nerves vomiting occurs in nephritis, or by calculi in the pelvis of the kidney or passing down the ureter.

(6) *Vesical nerves.*—In cystitis vomiting occurs. It may possibly be due, however, not to irritation of the vesical nerves, but to extension of inflammation to neighbouring parts.

(7) *Uterine nerves.*—Irritation of these nerves is one of the commonest causes of reflex vomiting. It may be produced in animals on irritation of the uterine plexus, and occurs in the human subject during pregnancy or in metritis.

(8) *Ovarian nerves.*—Vomiting is a symptom of inflammation of the ovaries.

(9) *The nerves of the testicle.*—A blow on this organ tends very readily to produce nausea and vomiting.

The cause of vomiting in *sea-sickness* is uncertain, but it appears to the writer to be partly due to the condition of the nerve-centres, and partly to that of the viscera. *See* SEA-SICKNESS.

TREATMENT.—The treatment of vomiting is to be directed to two ends (1) *to remove the cause* if possible; and (2) to *lessen the irritability of the vomiting centre.* The chief drugs which lessen the irritability of the vomiting centre are opium, morphia, bromide of potassium, chloral, and probably also hydrocyanic acid and belladonna. Strychnia and small doses of ipecacuanha are also useful in vomiting, and they probably owe their power to their action on the vomiting centre. Most of these drugs have a local sedative action on the stomach, and therefore it is advantageous to give them by the mouth when possible. Even when the stomach is very irritable, they may be retained by giving them in a concentrated form. When the stomach will not retain them, they must be given by the rectum or by subcutaneous injection. In sea-sickness the effect of the position of the head is sometimes very marked, and the vomiting may sometimes be arrested completely by removing all pillows and putting the head on a level with, or rather lower than, the body.

In cases of disease of the brain or its membranes, where it is difficult or impossible to remove the cause, we must try to lessen the congestion by means of leeches and cold applications to the head; and also to soothe the vomiting centre by hydrocyanic acid, or by bromide of potassium. At the same time, however, considerable benefit is obtained from the use of remedies which act locally on the stomach, these seeming to have some reflex effect upon the vomiting centre. One of the most useful is ice, which may be constantly sucked, and also swallowed in small lumps. Where the vomiting is dependent on the action of poisons circulating in the blood, as in the later stages of contracting kidney, we must endeavour to eliminate these by increasing the action of the kidneys and the skin. In vomiting dependent on inflammation of the mouth and fauces, we lessen the irritability by soothing or astringent gargles, confections, or glycerines. A confection or glycerine is often better than a gargle, inasmuch as it remains longer attached to the parts, and thus exercises a more prolonged effect upon them. When vomiting is due to irritant substances in the cavity of the stomach, such as indigestible food, and acrid fluids or poisons, it is best treated by evacuating them. A large draught of lukewarm water, alone or mixed with a teaspoonful of mustard, is one of the best means. Large draughts of warm water alone, even if they are not ejected, may give relief by diluting the acrid substances in the stomach so much as to prevent their irritating the mucous membrane. In this way they sometimes relieve sick-headaches. It is of great importance sometimes, not only to prevent the formation of acrid substances by slow and imperfect digestion, but to prevent the mechanical irritation of the mucous membrane by undigested food. For example, we not unfrequently notice that sickness and vomiting will occur in susceptible individuals after meals containing such substances as are not only slowly digested, but are swallowed in lumps. Examples of these are uncooked apples and cheese, or even potatoes, especially when imperfectly boiled or new. These articles, instead of being crushed to a powder by the teeth, are swallowed in lumps of considerable size, and apparently, instead of passing the pylorus, are retained in the stomach, and, partly by the mechanical irritation, and partly by their giving rise to acrid products, cause sickness. Milk, when swallowed in large draughts, or when there is too much acidity in the stomach, instead of falling in fine flakes will coagulate in large lumps, which have a similar effect to the cheese. To relieve this it is advisable to mix the milk with soda-water or lime-water, or to take it, as in the whey cure, by sipping.

When vomiting is due to slow or imperfect digestion, which allows decomposition or fermentation of food to take place in the stomach, it may be arrested by improving the digestion. Thus five grains of calomel, by acting on the stomach through the liver, may arrest vomiting; and tincture of walnut (the active principle of which, juglandin, is an hepatic stimulant) has also been recommended. Pepsine also, by facilitating digestion, may prevent vomiting; and bitters, such as calumba, may do so also, by preventing putrefaction or fermentation.

When decomposition or fermentation of food, with formation of acrid or irritating products, has once set in, it may continue a long time, as the organisms which cause it remain constantly in the stomach, and renew the process in every fresh supply of food. It may be stopped

by antiseptics. Where the vomited matters are frothy and yeasty-looking, the sulphurous acid of the Pharmacopœia, in doses of one fluid drachm, diluted with half a wine-glassful of water, often arrests such vomiting like a charm. Creasote has a similar action, but possibly has some additional action on the nervous system, as it is useful even in cases where the vomiting does not appear to be due to decomposition of food.

For the treatment of irritant poisoning *see* Poisoning.

When the mucous membrane of the stomach itself is inflamed or irritated, we must try to lessen the irritation. The best drugs for this purpose are ice, hydrocyanic acid, opium, and bismuth. The insoluble salts of bismuth, and especially the sub-nitrate, are to be preferred to the solutions; and it is advisable to combine them with magnesia, potash, soda, or carbonate of lime, according to the condition of the intestines, preferring the magnesia when the bowels are confined, and carbonate of lime when they are too loose. Sometimes the tendency to vomit is increased by lying on the right side. This is probably partly due to the drag of the stomach itself upon the cardiac extremity, and partly to the difficulty with which gaseous eructations escape from the stomach in this position. When there is a tendency to vomit, therefore, the patient should lie down on the left side after a meal. In the vomiting of hepatitis, in addition to opium and hydrocyanic acid, we may use ice-water, or ice swallowed, and leeches over the liver. In biliary calculus, we may give, along with opium, a full dose of ether internally, and in addition may employ ether or chloroform by inhalation; similar treatment may be adopted in cases of renal calculus.

In intussusception or hernia we must remove the cause, if possible. In peritonitis full doses of opium are best. For the vomiting in cystitis and ovarian diseases, we must lessen the sensibility of the vomiting centres by the drugs already mentioned, and treat the local conditions.

In the vomiting of pregnancy we trust partly to the drugs already mentioned to act on the vomiting centre, and partly to local applications. It is sometimes arrested by the application of a 10 per cent. solution of nitrate of silver to the os uteri, or by slight detachment of the membranes around the margin of the internal os. Where all other methods fail, the induction of premature labour must be resorted to. *See* Pregnancy, Diseases and Disorders of.

T. Lauder Brunton.

**VULVA, Diseases of.**—Synon. Fr. *Maladies de la Vulve*; Ger. *Krankheiten der Schamritze.*—The vulva or external genitals of the female comprise all the structures external to the hymen, having the navicular fossa and perineum behind, the urethral orifice, vestibule, clitoris, and mons Veneris in front, and at the two sides the nymphæ and labia majora. These organs may be the seat of many diseases, which will be described in the following order.

1. **Atresia Vulvæ.**—Closure of the genital fissure is sometimes found as a *congenital* malformation. This is usually of itself of no great importance, as it is almost always associated with other defects in development, as with atresia ani, hermaphroditisms, extroversion of the bladder, &c. *Acquired* atresia results from mismanagement of infantile vulvitis, from injuries of the pudenda in childhood, or from cicatrisation following upon some ulcerative process. It may give rise to trouble in micturition if the urethral orifice be involved. In rare cases it is only after puberty that trouble arises, from retention of the menses, or after marriage, from dyspareunia; or even during labour, from narrowness of the orifice delaying the escape of the infant. In the slighter and more recent cases, where the labia have only been agglutinated, they may be torn apart by pressure with the thumbs; or by passing a probe or sound behind the line of adhesion, and tearing it up with the handle of a scalpel, or with the nail. Where the union has become organised, the edge of the knife must be employed. In any case the patient should be anæsthetised; and care must be taken subsequently to prevent the reproduction of the adhesions.

2. **Inflammation.**—Synon.: *Vulvitis.*—Inflammation of the vulva may be (*a*) *general*; or (*b*) *localised.*

(*a*) *General vulvitis.*—This variety is found affecting the apposed aspects of the labia, and the whole of the mucous surface they enclose, up to the borders of the hymen. It may be due to gonorrhœal infection, in which case the catarrhal process is apt to extend to the urethra and the vagina. In infants and young children of strumous constitution, it sometimes arises from exposure to cold, want of cleanliness, or irritation from ascarides that have passed out of the anus. In the adult it may result from injury, or rude coition; or from the escape of acrid uterine or vaginal discharges. It shows itself with heat, and tenderness or sometimes itching in the part; a discharge of viscid glairy mucus bathes the surfaces, which sometimes becomes purulent, and glues together the labia. When the labia are separated the seat of the mischief is exposed, and is seen to be red, and sometimes resentful of touch. Apart from the constitutional remedies that may be indicated in individual cases, the treatment consists in keeping the parts at rest, and carefully clean; and in bathing or douching the surface with hot water, followed by an astringent lotion or dusting powder.

(*b*) *Localised vulvitis.*—The vulvitis may be localised—(α) in the *vestibule*; (β) in the *navicular fossa*; or (γ) in the muciparous *follicles* and *glands*, and especially in the *Bartholinian glands.* (α) and (β) occur under the same conditions as the more diffused inflammation, and may be a source of considerable distress in walking or when the part is touched, without being attended by any leucorrhœal discharge. Such cases require the same treatment as cases of general vulvitis; only it is important to make the applications directly to the affected spot, and hence it is usually best to apply sulphate of copper, in the form of a solid crystal. (γ) Inflammation in the Bartholinian glands is the commonest cause of *labial abscess.* It may attack females at any age, but is most frequently seen in women from twenty to thirty, whether married or unmarried. It may arise during pregnancy, and some women are liable to repeated attacks, the

glands becoming swollen and cystic whenever the patient gets a chill. In some cases there is profuse secretion, which escapes freely. Far more frequently the swelling in the lining of the duct leads to occlusion. This occlusion is in some instances transitory, and when the swelling in the duct and around its orifice subsides, the secretion that had accumulated escapes. In other instances the duct becomes permanently closed. These are the cases where the patient acquires a swelling in the labium majus of the affected side, varying in size from a pigeon's to a hen's egg. The accumulated fluid may be clear and limpid; but often it is turbid and distinctly purulent. In all the suppurative cases, if the cyst be evacuated through a small opening, the fluid is apt to reaccumulate, and the cyst-walls are now more likely to be the seat of a mischievous inflammation. So that the treatment consists first in trying to reduce the inflammation with hot fomentations or poultices, perhaps aided by sedative lotions containing belladonna or laudanum, with the view of getting the orifice relaxed; and where the contents do not escape through the duct, the cyst should be freely opened, and the cavity cauterised. Huguier's suggestion, to extirpate the gland, is not ordinarily required, especially if the evacuation be effected with a Paquelin's thermo-cautery, which first makes a large and safe cut into the cyst, and can then be applied to the interior, so as to destroy the secreting surface.

*Specific inflammations.*—The specific inflammations, *gonorrhœal* and *syphilitic*, are treated of in their respective articles. But it is to be noted that the vulva may be the seat of *erysipelas*; and female children have sometimes suffered from a gangrenous vulvitis or *noma*, of the same nature as the noma of the mouth and cheeks, which may come on after some of the eruptive fevers, such as scarlatina, and require the same kind of treatment, with chlorate of potash and tincture of the muriate of iron and stimulants, from an early stage of the mischief.

**3. Eruptions.**—Various forms of eruption may be met with in the vulva, sometimes on the nymphæ or internal aspect of the labia majora, sometimes on the external aspect, and extending to the mons Veneris, or inside of the thighs. The commonest are *eczema*, *erythema*, *herpes*, *prurigo*, and *acne*. They are diagnosed and treated in the same way as the same affections in other situations. It is to be remembered, however, that the tendency to chronicity, which is a marked feature of inflammatory processes in the sexual apparatus generally, is apt to show itself in these vulvar eruptions, and that patients, from motives of delicacy, are apt to allow them to remain untreated for too great a length of time. Further, many of them give rise to itching, which tempts the patient to rub and scratch herself to obtain relief, and may thus cause pruritus.

**4. Pruritus.**—Ætiology.—Itching of the vulva is a not infrequent symptom of some of the eruptive and inflammatory affections of the part, either when these are healing or have got into a chronic stage, and it may remain as a permanent trouble after healing has taken place, if the patient have acquired the habit of relieving herself by friction. Sometimes it is reflex, from oxyuric irritation in the rectum, or when the worms have travelled from the anus to the vulva. Or it may be associated with disease of the vagina or uterus, as in cases of chronic colpitis or carcinoma of the cervix, in which the itching may either be due to irritation from the nature of the discharge, or be a reflex phenomenon. In some instances it can be traced to circulatory disturbance in the labia, as when the veins are enlarged, and in the congestion of early pregnancy. In others the renal secretion is at fault; and it is such a common phenomenon in women who are the subjects of diabetes, that in every patient who suffers from pruritus vulvæ, the urine should be tested for sugar. Lastly, there are some cases that can only be described as idiopathic.

Symptoms.—The itching may be localised on the internal aspects of the nymphæ, or of the labia majora, or around the clitoris or the perinæum. In most cases of long standing it becomes diffused all around to the anus and inside of the thighs. Sometimes it is temporary, as in the pruritus of pregnancy, which passes off under careful management in a few weeks, or in rarer cases during the puerperium; in other patients it becomes chronic, and constitutes one of the most distressing troubles to which the female is liable. The itching may come on only occasionally. For the most part it is likeliest to prove distressing when the patient is warm, as at bedtime, or after exercise; but with some the feeling is never quite in abeyance, and the patient has the almost constant desire to relieve herself, as for a time she can do, by scratching, or rather, rubbing the parts with her dress or a towel, until the pain overcomes the feeling of itch, or sometimes until the collapse consequent on the onanistic orgasm which she has involuntarily produced, renders her for a time less sensitive to her trouble. The result of such friction, however, is to keep up the local irritation; so that even in cases where there may not originally have been any local pathological change, but where the itching and friction have persisted for months or years, the skin and mucous membrane become thickened and indurated, and a condition resembling that of a chronic eczema becomes induced. In two cases the writer has seen epitheliomatous nodules develop at the sides of the clitoris and in the vestibule.

Treatment.—When diabetes is present it must be combated; and if the patient is gouty, or have her urine too acid or alkaline, these conditions must be rectified. Morbid processes that may be present in the vulva or other neighbouring structures must be treated according to the requirements of the case. A carefully regulated non-stimulating diet should be enjoined, and a due amount of exercise. The internal remedies that have been found most helpful are bromide of potassium and arsenic. Then, for the relief of the itching, the patient must be warned against the danger of rubbing the parts, and be taught to soothe it by bathing with very warm or sometimes with cold water, and drying the parts with a soft towel or napkin. It can be still better allayed by mopping with a lotion containing infusion of tobacco or belladonna or opium; or by applying afterwards a piece of lint soaked in

black lotion, or a lotion of acetate of lead. The most effectual sedatives are ointments containing sulphur, camphor, tar, carbolic acid, thymol, iodide of lead, bichloride of mercury, bismuth, prussic acid, or iodoform (deodorised with tonquin bean).

5. **Tumours.**—The following enlargements may be found in the vulva:—

(*a*) *Hypertrophy.*—The clitoris has sometimes been found of a size sufficient to cause discomfort, and warrant its removal. Far more frequently the nymphæ are of unusual dimensions, their margins projecting beyond the labia, and then they are liable to become the seat of ulcerative processes, and require to be trimmed, which may be done with the knife or scissors, but better with the thermo-cautery. Enlargements of the labia majora, in the form of elephantiasis, are met with among Hindu women. The mass is sometimes of enormous size, and in consequence of the calibre of the nutrient vessels, ablation is apt to be attended with dangerous hæmorrhage, so that the application of an elastic ligature is in most cases the best means of effecting its removal.

(*b*) *Hernia.*—Hernial protrusions may occur into the labia, and be found among the swellings of this part. The detection and treatment are to be effected and conducted as in the case of other herniæ.

(*c*) *Cysts.*—Cystic swellings are found in the upper part of the labia, when the canal of Nuck becomes the seat of an accumulation of fluid, which corresponds to hydrocele of the cord in the male; or lower down, when the duct of a Bartholinian gland has become occluded, and the secretion of the acini accumulates so as to distend the gland without its becoming inflamed. If a complete aspiration in either case is not followed by perfect cure, and the fluid reaccumulates, as it is apt to do, the second tapping should be accompanied with an injection of iodine; and in the case of the Bartholinian cyst, the wall of which is formed of a mucous rather than of a serous membrane, the evacuation may require to be effected through a larger opening, and followed by the application of a more powerful escharotic.

(*d*) *New growths.*—Various neoplasms may have their seat in the vulva. At the orifice of the urethra not infrequently small red-flesh growths, the so-called *urethral caruncles*, make their appearance. They are sometimes unattended with any symptom; more frequently they cause intense suffering during micturition, during coitus, or when the patient takes exercise. The pain is usually referred to the urethral orifice, but it is sometimes reflected to distant parts, as, to the heel. Relief from suffering may be temporarily obtained by application of sulphate of copper or nitrate of silver; but cure is only effected by removal of the growth. It is imperatively necessary to remove not only the small red body, but the portion of the urethra from which it springs, and the raw surface should be freely cauterised if the ablation have not been effected with a thermo-cautery. *Specific* swellings, warty or gummatous, are, of course, frequently to be met with on the vulva. *Lipomata* sometimes grow under the skin of the labia pudendi. More frequently *fibromata* occur, which may attain considerable size, and demand removal. Lastly, the law that *carcinomata* have a predilection for surfaces where a transition takes place from one variety of epithelium to another, is illustrated by the frequency with which different forms of cancer affect the vulva. Their development, symptoms, and treatment present no special features. Only it is well to remember that when the mischief is met with in a stage where there is still hope of its eradication, it is best to effect the removal of the neoplasm by some of the bloodless methods with which modern surgery has become familiar. The tissues in which the growth develops are very vascular; and whilst in some situations—as at and around the clitoris—it is comparatively easy to control hæmorrhage by pressure against the pubic bones, in the parts immediately to the side and back of the vaginal aperture the bleeding from a cut surface is apt to be uncontrollable and dangerous. Hence commencing carcinomata ought to be extirpated with the écraseur, or better still with Paquelin's thermo-cautery, which is the most serviceable of all instruments for the removal of the different varieties of neoplasm that infest the vulva.

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# W

**WAKEFULNESS.** *See* SLEEP, Disorders of.

**WARTS.** *See* VERRUCÆ.

**WASTING.**—A synonym for atrophy. *See* ATROPHY, GENERAL; and ATROPHY, LOCAL.

**WASTING PALSY.**—A synonym for progressive muscular atrophy. *See* PROGRESSIVE MUSCULAR ATROPHY.

**WATER, Ætiological Relations of.** *See* DISEASE, Causes of; and PUBLIC HEALTH.

**WATER, Therapeutics of.** *See* BATHS; HYDROTHERAPEUTICS; MINERAL WATERS; and SEA AIR, SEA BATHS, and SEA VOYAGES.

**WATER BRASH.**—A popular synonym for pyrosis. *See* PYROSIS.

**WATER CANKER.**—A synonym for cancrum oris. *See* CANCRUM ORIS.

**WATER ON THE BRAIN.**—A popular synonym for hydrocephalus. *See* HYDROCEPHALUS, Chronic.

**WATERS, MINERAL.** *See* MINERAL WATERS.

**WAXY DISEASE.**—One of the synonyms for albuminoid disease. *See* ALBUMINOID DISEASE.

**WEAL, WALE, or WHEAL.**—This is an Old-English word signifying the mark of a stripe, that is, the prominent pale ridge caused by the stroke of a lash upon the skin. The term is applicable especially to the prominent risings of a lengthened figure which are met with in urticaria, in contradistinction to the button-like tubercles or protuberances of that affection. *See* URTICARIA.

**WEILBACH, in Germany.**— Sulphur waters. *See* MINERAL WATERS.

**WEN.**—A popular term for a tumour of the integument, without reference to its pathological structure. Wens are commonly fleshy or encysted; in the latter case proceeding from distension of the sac or excretory duct of a cutaneous gland, more especially a sebiparous gland.

**WET-PACK.** *See* HYDROTHERAPEUTICS.

**WHEEZING.**—A peculiar sound, of a dry piping or whistling character, which may be heard in connection with the respiratory organs during the act of breathing, and caused by certain forms of obstruction to the passage of air. *See* ASTHMA; BRONCHI, Diseases of; and PHYSICAL EXAMINATION.

**WHIFFING.**—A peculiar quality of a murmur heard in connection with the heart and vessels. *See* HEART, VALVES OF, Diseases of; and PHYSICAL EXAMINATION.

**WHIP-WORM.**—This term is not unfrequently applied to the small human nematode that is better known to the profession as the *Trichocephalus dispar*. Several of the older writers, following Büttner, supposed that the whip-like portion of the body formed the tail; hence the generic term *Trichuris* under which they described the parasite. Whip-worms not only infest man, but also several of our domesticated animals, which latter, however, as in the case of the human host, rarely suffer in consequence of the invasion. *See* TRICHOCEPHALUS.

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**WHISPERING PECTORILOQUY.**—A form of pectoriloquy in which the whispered voice is distinctly heard. *See* PECTORILOQUY; and PHYSICAL EXAMINATION.

**WHITE GUM.**—A popular name for the white form of strophulus, *S. albidus*. *See* STROPHULUS.

**WHITE LEG.**—A synonym for phlegmasia dolens. *See* PHLEGMASIA DOLENS.

**WHITE SWELLING.**—A synonym for scrofulous disease of a joint. *See* JOINTS, Diseases of.

**WHITES.**—A common synonym for leucorrhœa. *See* LEUCORRHŒA.

**WHITLOW.**— SYNON.: Paronychia; Fr. *Panaris; Tourniole*; Ger. *Paronychia.*

DEFINITION.—Whitlow is a term somewhat loosely applied to any acute inflammation of the finger or thumb, which tends rapidly to terminate in suppuration, and is not limited to the matrix of the nail, in which case it would be called *onychia*.

Whitlow may be divided into four chief varieties, but these often merge into one another.

1. **Paronychia ungualis.**—SYNON.: Superficial whitlow of Abernethy.—This form is limited to the ungual phalanx. The skin only is affected, and frequently at the side of the nail. It commences usually as the result of some slight injury, such as a bruise or puncture, or from the inoculation of septic or other irritating matter. The first signs are heat, tenderness, and itching in the inflamed part. The pain is not severe. On the third or fourth day pus forms, raising the epithelium from the cutis vera, and as it cannot point through the dead cuticle it remains pent up, and the tension so caused increases the pain, and if unrelieved leads to ulceration of the true skin, the pus then finding its way into the cellular tissue beneath. The whitlow then merges into the second variety. It may also spread to the matrix of the nail, and so become complicated with onychia. If relieved early, by cutting away the cuticle which has been raised by the pus, it seldom leads to any unpleasant consequences.

TREATMENT.—The treatment consists in bathing the finger frequently in hot water, and applying lint soaked in hot water, which is cleaner and better than a poultice. A combination of equal parts of glycerine and extract of belladonna will be found an invaluable application, frequently cutting the inflammation short, and always relieving the pain. As soon as there is any sign of the cuticle being raised by fluid beneath, it should be cut away with a pair of scissors, or a razor or sharp knife. An incision is never necessary.

A form of superficial whitlow is sometimes seen occurring without any apparent cause, and attacking one finger after another. The fluid beneath the cuticle is not always purulent—sometimes being merely albuminous, and mixed with flakes of lymph. It never leads to any deep suppuration. It is most common in children and females, and is consequent upon general debility. It is described by the French under the name of *Tourniole* or *Panaris phlyctenoïde*. It is a troublesome affection, and difficult to get rid of. Tonics and iron are the most important remedies. Sometimes arsenic is of use.

2. **Paronychia cellulosa.**—The inflammation in this variety commences in the cellular tissue of the pulp of the ungual phalanx. It arises almost invariably as the result of some slight puncture or other injury, or as the consequence of neglecting the variety just described. The tip of the finger is swollen, tense, and excessively tender. There is severe burning, throbbing pain, and possibly red lines spread-

ing from the inflamed part in the course of the lymphatics. There is more or less fever, with general constitutional disturbance. Pus forms by the third or fourth day. It tends to point through the skin, but the thick cuticle usually resists its pressure for some time, and if this be not cut away early the gravest results may ensue. The pus may find its way into the sheath of the flexor tendons; or the bone may be exposed, and necrosis may follow, the disease then merging into the two following varieties. If an incision be made about the fourth or fifth day, a large slough will usually be found beneath the skin.

Treatment.—A free incision must be made longitudinally into the pulp of the finger as soon as the condition is recognised, and by this means all complications will be averted. If the pus have already found its way through the cutis, and be pent up beneath the epidermis, it is often sufficient merely to cut away the loosened cuticle with scissors. In other respects the treatment is the same as for the first variety.

3. **Paronychia tendinosa.**—Synon.: Thecal abscess.—This is usually classed with whitlow, and is often secondary to the other varieties. It frequently begins, however, as a primary inflammation of the sheath of the flexor tendons. It is supposed by some to be related to erysipelas, and in many cases it probably is so; but frequently its cause is uncertain. It may arise from a wound opening the sheath of the tendon, but then would hardly be called a whitlow. The whole finger swells, and becomes tense and red. The pain is most severe, usually shooting up the hand and arm. Pus forms early, and if not evacuated by incision, exposes the bones, destroys the tendons, burrows into the joints, and rapidly destroys the finger. If affecting the thumb or little finger, the sheaths of which are continuous with the common sheath at the wrist, the suppuration rapidly extends to the palm of the hand, and to the forearm above the annular ligament. The wrist-joint may then be opened, and destruction of the whole hand result. The constitutional disturbance and fever are usually very marked. The disease is most common after middle life, and in patients of a broken constitution. The affected finger or hand seldom recovers perfect utility; and death is not uncommon, either from exhaustion or from some secondary complication.

Treatment.—Hot baths to the hand, fomentations and poultices, and free and early incisions are required. Glycerine and belladonna is a most useful application, Stimulants, good diet, and tonics are always necessary.

4. **Paronychia osseosa.**—This is a somewhat rare variety of whitlow, arising sometimes from injury, sometimes without apparent cause. It is an acute inflammation of the periosteum of the ungual phalanx. It is characterised by redness and swelling, with most intense aching and tensive pain, and acute tenderness. If an incision be made as soon as pus is recognised, the bone will be found to be already bare and necrosed. This condition can only be averted by cutting down to the bone before suppuration has occurred, and this is rarely possible.

Treatment.—This is the same as in the other varieties, namely, hot applications and free incisions. The necrosed phalanx must be removed as soon as it is loose. If more than one phalanx be affected, amputation may be necessary.

One or two points common to the treatment of all varieties require further notice. All incisions should be made as far as possible in the middle line, so as to avoid wounding the digital arteries. The sheath of the flexor tendons should on no account be opened, unless there is pus within it. In all doubtful cases an anæsthetic should be administered, the limb made bloodless by Esmarch's method, and the incision carried carefully towards the flexor tendons. In this way the exact situation of the pus can with certainty be ascertained, and an unnecessary wound of the sheath of the tendon avoided. Incisions are frequently made into the pulp of the ungual phalanx of the finger when the pus is really on the dorsum. This arises from the sense of fluctuation yielded by a swollen finger covered by somewhat thick cuticle. In all cases the cuticle should be cut away as soon as it is loose, and not allowed to hang about in shreds caked with putrid pus and linseed meal. The best application in all cases is boracic acid lint, three or four layers thick, wetted with hot water, and covered by oiled-silk and cotton wool. This is perfectly clean, and in every way as efficient as a poultice. Soaking the hand frequently for an hour at a time in an arm-bath usually gives great relief in the more severe forms.

Marcus Beck.

**WHOOPING-COUGH.** — Synon.: Kincough; Hooping-cough; Pertussis; Fr. *Coqueluche*; Ger. *Keuchhusten.*

Definition.—An infectious specific disease, chiefly affecting children, lasting six or eight weeks, rarely attacking the same person twice, and accompanied by a peculiar spasmodic cough. The cough, not characteristic till the second week, comes on suddenly with some quick, short, forcible expirations, and flushed face; then a long, shrill inspiration, or whoop, and several rapid coughing efforts in repeated paroxysms occur, ending in the expulsion of viscid mucus, or in vomiting. A return of cough is readily excited for some time after the disease has subsided.

Ætiology.—Infectious particles thrown off by the cough, and carried to the air-passages of the susceptible, there fixing and multiplying, set up the same series of disturbances by which they are produced, reproducing abundantly more infectious material. Whooping-cough occurs in epidemics, chiefly prevalent in the spring, extending over a large part of any town or district associated by various means of intercommunication, or by common educational establishments, and spreads as long as young children who have not had the disease before are brought within its influence. For a disease of this kind, attacking the respiratory surfaces, and then exciting a specific secretion, with violent cough to scatter it, a more widely diffused air-borne infection might be imagined than for other infectious diseases. There is no proof that such infection is ever carried across any wide distances; what the limit may be for such trans-

portation is quite uncertain. From the reception of infection to the evidence of its effects, an interval for incubation always intervenes. When children are said to have been attacked soon after exposure to keen air, this has only roused into activity a cause already in operation. Some quality of the air or season may act as a predisposing cause. Certain bodily states—the condition of teething, and that left after measles and some other diseases—predispose the mucous surfaces to receive and foster the germs of whooping-cough. This infection is often received with that of measles, and the characteristic cough of the one disease is not recognised till the rash of the other has passed away. Three weeks may elapse before children, who have been exposed to infection, show signs of it by the whoop; they, therefore, should not mix with others who are susceptible till this period is safely over. Infection persists for six or eight weeks after the disease is declared; after this there may be a return of cough or spasm without fresh danger of infection. During the illness any bit of mucus thrown off by the cough may be the medium of infection; whether other secretions are infectious is a matter of doubt; emanations from the sufferers may be so even after death. The disease is readily propagated by *fomites*; it is frequently carried from house to house by the clothes of visitors; the sick create an atmosphere around themselves into which the susceptible cannot enter without danger of being seized; a portion of this atmosphere is easily removed and carried in the folds of dress to other houses and rooms. Some infectious particles cling to the clothing of convalescents for a long time. Active infection is given off by those affected slightly, or only beginning to be so, while sickening for the disease; even the insusceptible, who are not liable to suffer in the same way again, may have slight cough or irritable throat after being with the sick, and so, ailing little or nothing themselves, be the means of carrying infection elsewhere.

Whooping-cough prevails so extensively in early childhood, that it is rare to find anyone grow up without having been exposed to it. Those who escape infection in childhood mostly escape it altogether. Adults are rarely seized. When this happens—and no age is exempt—the disease goes through its full course with the same symptoms as in infancy, but with none of the dangers then arising, only with the vexations of a tiresome and embarrassing ailment.

The greatest number of cases occur in children under eight years of age. It is one of the three diseases most fatal to young infants, and like the bronchitis of cold weather, and the diarrhœa of summer, is most fatal to the youngest; it differs from these in not being more fatal either in very hot or in very cold years. Whooping-cough comes next to scarlet-fever in the number of deaths attributable to it in this country, the proportional mortality from this cause being five or six per ten thousand of population, and nearly 2½ per cent. (one-fortieth) of yearly deaths from all causes. Three-fourths of all the deaths from it are of children under two years of age; yet more than 40 per cent. of all the mortality falls in the first year, over 30 in the second, about 15 in the third, 6 in the fourth, 4 in the fifth year, and less than 4 per cent in the next five years. Sex has a marked influence on the fatality of whooping-cough. Girls suffer more than boys. While half the attacks of boys are severe, five-sixths of the attacks among girls are so; the deaths of girls being nearly one-third more than of boys. If the proportion of deaths to attacks is put at 2½ per cent., so great is the difference made by age, that the range must be from 10 per cent. or more in the first two years to a decreasingly lower rate afterwards, with a smaller variation for sex. Race and climate make little or no difference as to the liability to whooping-cough. Season has an influence on its epidemic extension; this with us is always in the spring. Cold indirectly adds to the intensity of the disease; it is increased by overcrowding, bad ventilation, and the confinement of the sick in close apartments. All the hygienic defects which lead to rickets in that way add greatly to the bad effects of whooping-cough.

The period of incubation is well-marked in all cases, and extends from four days as the shortest limit, to ten days or a fortnight as the longest; in the latter instance, a solitary one, no catarrhal symptoms were noticed till thirteen days after a single limited exposure, the whoop appearing ten days after that. Usually some catarrhal and febrile symptoms, with or without cough, appear from the fourth to the seventh day after exposure to infection. The invasion, or catarrhal, stage lasts a week. The whoop mostly begins ten days from the ingress, unless accidentally delayed; it has been heard as early as the eighth day, or as late as the twenty-fifth and even later, or not at all. A healthy infant, born amidst whooping-cough, sickened at the end of the first week, and survived a fortnight; another, it is said, was infected on the second day, and whooped on the eighth. A child, whose mother had herself been four weeks ill with this disease, is stated to have been born with whooping-cough. The complaint has not been directly produced by inoculation.

Pathology and Anatomical Characters.—The course and duration of all the symptoms of pertussis are too constant and definite for the cough and other results of the disease to be deduced from the effects of any kind of local irritant on the mucous surfaces of the air-passages. A specific catarrh with hyperæsthesia is admitted by all. Is this located chiefly in the bronchi (Broussais and Guersant); limited in the first instance to the laryngo-pharyngeal mucous crypts (Gendrin); or confined within the larynx (Beau)? The latter view is supported by the redness seen extending from the epiglottis to the vocal cords; and by the tumefaction, and viscid or puriform secretion, found in the larynx after death. But the larnyx may redden only when the cough begins, and this may be excited by mucus rising into the trachea from below as well as by that touching the glottis from above. As neither laryngitis nor bronchitis in children is attended with persistent spasm, a cause for this has been sought in the swelling of the bronchial lymphatic glands so often associated with spasmodic cough. This source of reflex excitement of the vagus is applied by Dr. Noël Guéneau de Mussy to explain

the recurrence of spasm long after the usual term, rather than advanced as an explanation of the character of the cough throughout the disease; he suggests, however, that the absence of spasm from the first stage of the disease, or its delay, may be from the bronchial glands not being very much enlarged in such cases. The small lymphatic glands in the neck and along the trachea and bronchi are affected early both in this disease and in measles; their enlargement is much less marked in adults than in children, yet adults have the same spasm in the second stage of whooping cough; and in the serious pulmonary lesions after measles children have not the same kind of cough. The explanation is in the specific or contagious element. In ordinary catarrh or bronchitis the spasm yields when secretion begins. Here the same contagious matter that began the irritation not only keeps it up by local increase, but, multiplying vastly for a certain time, is thrown off by the surfaces where it proliferates, or to which it is carried, perhaps with added virulence and activity. A less permanent, less energetic, or less extended irritation of all the sensory terminations of the pneumogastric nerve would not so excite and increase the susceptibility of the nerve, while diminishing and exhausting its power, thus modifying the nutrition and function of its centre; the change so impressed continuing long after the original exciting cause has ceased. A special influence may from the first be attributed to the specific cause. A certain degree of hyperæmia would determine fever, distend the lymphatics, and excite cough by irritation of the peripheral nerves. But the nerve-centres both of the respiratory and sympathetic system are disturbed in the earlier stages, and the vagus specially implicated before the enlarged bronchial glands or other local causes of excitation are established. The impaired function of the pneumogastric is shown by the rapid and weak pulse, epigastric tenderness, loss of appetite, weak respiration, and pulmonary congestion; this aids the impulsion of morbid products to the bronchial surface, hence a specific secretion and a further source of reflex irritation, hyperæsthesia, and the special characters of the cough. The element of contagion whatever it may be, is reproduced abundantly in this catarrhal secretion, for a definite time, after which it does not reappear; the cough or spasm may return for months, but no real relapse of the disease. One attack is protective against a recurrence. The disease then is zymotic, and essentially neither a neurosis nor a bronchitis, though both of these conditions are excited by it. Zymosis may be either by a local proliferation, or a general infection, or both; it has been thought sufficient in this case that contagia should reach to the surfaces of the air-passages; these acting locally upon the mucous membrane may entail all the consequences of the disease in the former mode only; and some altered ciliated cells, which could not possibly enter the blood, have been figured as the infecting and infected bodies. On the other hand, bacteria, as seen by V. Potain, and micrococci, described by Letzerich as in mucus only, and seen by others, abound in the secretions, penetrate the cell-structures, and are found in the leucocytes of the blood and tissues. These differ little, if at all, from those of ordinary occurrence, except in their number and rapidity of increase. It is unlikely that the common forms could acquire special quality from accidental inflammation around them; but these, derived from a special source, may carry with them special qualities setting up the same action in a suitable medium as that in the tissue from whence they were derived; they permeate freely, and the process has ceased to be local before the signs of disease are observed. The part taken by the white corpuscles of the blood, as agents of absorption and infection, cannot be overrated.

As in the exanthemata the rash shows impaired vaso-motor nerve-control, so in whooping-cough the irritability of the surface of the pharynx, glottis, and trachea is early evidence of disturbed innervation. There is no deep-seated congestion of the fauces; the catarrhal state is more marked below the glottis than above, the trachea is often pale, the bronchi are always congested, and the smaller lymphatic glands along their course, and beside the trachea, as well as the larger bronchial glands, are red and swollen, so as to be constantly pathognomonic; later these or the mediastinal glands may show centric softening. The bronchial membrane is thickened, red, and covered with sticky masses of secretion, in which groups of micrococci are found; the viscid secretion in the smaller bronchi is an almost constant condition, and its liability to be drawn into the pulmonary alveoli a prominent character of the disease; such blocked alveoli look like tubercles under the pleura; if punctured the contents will squeeze out. Ecchymoses are seen on the pleuræ, and sometimes in the pericardium. The œsophagus is pale, but the mucous membrane of the stomach is often swollen and red, with punctiform injection or petechial spots; effused blood has been found in the bowels; a follicular inflammation of the intestines is associated with gastric catarrh; and there is some enlargement of the mesenteric and retro-peritoneal glands. The liver is more often hyperæmic than the spleen, with some fatty cells; or is large, with yellowish-grey fatty change in the tuberculous or rachitic. There is no definite kidney-lesion. Cerebral effusions, like chemosis or œdema of the face, are the accidents of cough and dyspnœa. Spasmodic cough is not merely a reflex from the upper laryngeal nerve; shallow respiration and insufficient oxygenation excite respiratory efforts, but if no more air gets to the blood, expiration is accentuated, and goes on in a convulsive repetition, due to the stimulation of the medulla by the venous blood; this happens on any interference with the supply of oxygenated blood to the respiratory centre, and from these efforts exhaustion results. When the centre recovers its excitability, inspiratory effort follows, and on the rapid alternations of these states much of the frequency, force, and duration of the paroxysms depend. Repeated distension of the right cavities of the heart in the fit cause various venous hæmorrhages. Obstructed air-cells, catarrhal pneumonia, and lobular collapse of lung, with surrounding emphysema, also occur as secondary phenomena. These, with cerebral congestion, result from

futile cough. Impeded respiration leads to convulsions in children; most, if not all, of the cerebral symptoms during the illness are indicative of some further mischief in the lung. In rickety subjects these complications, together with the greater tendency to spasm in this diathesis, produce bending in of the ribs and contraction of the chest, often interfering greatly with healthy development in later years.

Symptoms.—The invasion of whooping-cough is insidious, rarely with chills. Some fever or cough is first noticed at night; the child is better next day, but loses appetite, is fretful, or looks pale and languid; the pulse is quick, and the respiration shallow; there may be sneezing or signs of catarrh, but these mostly appear after another night of fever, or of teasing, frequent cough, which may be croupy before secretion begins; the glandulæ concatenatæ are perceptible to touch; instead of a freer secretion relieving the symptoms, as in ordinary catarrh, it is thin, and they increase; there may be high fever, with pulmonary congestion, or the fever subsides, and bronchial *râles* are heard on deep inspiration. This is known as the *catarrhal stage*. It lasts eight or ten days, the whoop being seldom heard till the end of the second week. But the period is not definite, for the fever of this, as of the other two stages of whooping cough, is marked by great irregularity, with intervals quite free from fever; in this stage it may be prolonged by various complications, or be very little noticeable. In the latter case the cough is sooner distinctive; it comes on in fits, mostly at night; in the day there are intervals without cough. When the cough is coming, the child's face reddens, as if trying to suppress it, till it bursts out in a series of short, quick forcible efforts; then the breath is drawn in with a shrill whistling sound, again followed by the boisterous cough; after a short pause comes a less severe and shorter fit, and then another, till a quantity of whitish viscid mucus is expelled, some perhaps through the nose, and some swallowed, or the child vomits at the same time, ejecting the contents of the stomach.

When the secretion is free the catarrhal stage is over, and the *spasmodic stage* begins. At this time laryngoscopic observation has shown the mucous membrane pale to the lower third of the trachea; before the cough whitish mucus has been seen to rise to the bifurcation of the bronchi; then cough begins; some time after it is over the vocal cords have been observed to be redder than before. Bronchial catarrh is as much a feature of this stage as the spasm. When the cough seems to have come on without cause, the secretion has risen to the trachea; children are often old enough to describe a tickling in the throat before the cough, they show dread of its approach, and prepare for the attack, by steadying themselves, or clinging to others for support; they are glad when it is over, and seem afterwards cheerful in the day, and go to sleep again at night. Not so with younger children; before the attack the pulse quickens, the breathing is short and insufficient, *râles* are heard, spasm closes the glottis, the air is forced out in sudden jerks, and then enters with the loud long-drawn whoop; this is repeated till the face becomes livid and swollen, and the child exhausted or semi-conscious. Frequent attacks of this kind keep the face puffy; may produce small ulcers on the frænum linguæ; and make the eyes red and watery, often with small hæmorrhages into the conjunctivæ. Or blood starts from the nose and mouth in the paroxysm, and is seen in the matters vomited, while both urine and fæces may be passed involuntarily. In some cases diarrhœa and vomiting are serious symptoms. While the cough forces air from the lung, the percussion note is dulled, and becomes again resonant after the sibilant inspiration is heard. The heart's action is impeded, sometimes interrupted by the passive congestion reacting on its cavities during the cough, or from irritation of the vagus; neither endocardial nor pericardial lesion is found in whooping-cough, and nothing is found wrong with the heart after the fit is over.

Examination of the chest in the intervals of cough reveals the usual signs of whatever pulmonary complication is present. In most cases mucous rhonchus is heard over the larger bronchi, and some finer rhonchi on deep inspiration, with weak respiratory sounds; moist or dry crepitation replaces these in places where the finer bronchioles or alveoli are affected; this may occur without much capillary bronchitis or pneumonia in the following way:—Violent spasm prevents air entering some of the smallest tubes, the epithelium thus loses its cilia, and, mixed with muco-purulent secretion, blocks a small lobule or fills an alveolus; this happens when the fits of cough are worst and most frequent; with closed glottis the forcible expiratory efforts compress the contents of the alveoli, and squeeze out the fluid parts, leaving the débris to caseate; a dry crackle, rather than moist bubbling *râles*, may be indicative of this. Meanwhile air in some peripheral lobules, compressed in the same way, gives rise to vesicular emphysema; this state of lung can recover itself sooner than the other. A more extensive capillary bronchitis or catarrhal pneumonia is shown by grave general symptoms, restless tossing, rapid breathing, dusky face, coma, and convulsions.

Without these complications, the *third stage*, of subsiding spasm and loose expectoration with returning health and strength, may be reached in from four to six weeks. The mildest cases may seem to be over sooner, with one week for the catarrhal stage, and two for the spasmodic; but any little want of care will intensify the symptoms; and relapses are common until six weeks are accomplished, even in cases where the second stage has not been prolonged beyond four weeks. The disease often lasts two months, and is followed by a tedious convalescence. The pulmonary deposits may originate tuberculosis. The disturbances of nutrition and innervation are long in being restored; some of the accidents of rickets never.

Diagnosis.—Influenza has dry, frequent cough, paroxysmal, and worse at night, with gastric and febrile symptoms, hardly distinguishable at first from those of the ingress of whooping-cough; but influenza prevails as a widely

spread epidemic, not limited to children only and to a particular neighbourhood, but affecting persons of all ages; there is more coryza; it has a crisis in five days, and is mostly over in ten days, and relapses are frequent; the same persons are attacked more than once, sometimes even in the same epidemic. In children if cough persists, it is without whoop; the conjunctivæ may be red, but have no blood-effusions; no small ulcers form under the tongue. Bronchitis comes on in cold weather directly after exposure or chill; the breathing is quickened from the first. Infantile laryngitis also has no stage of incubation. Laryngeal diphtheria has no remissions. Both alter the voice and cry. Some catarrhal attacks among children, coming on with fever, often with laryngeal irritation, and with fulness of the small cervical glands, are less readily recognisable; in these, if the breathing at first be less quickened than the pulse, this difference ceases as soon as lung-mischief begins. An opinion can only be given after some delay and caution, unless, as is also the case with measles, the child is known already to have had these diseases. A first question is, What infantile ailments are over? the next, What have been the chances of exposure? Hay fever occurs in the summer, mostly in adults; it attacks certain people only, and these every summer; if the first attack were supposed to be whooping-cough, the mistake could not be made a second time. The spasmodic cough of hysteria is incessant, and without whoop; it is only contagious by imitation.

Prognosis.—Young children under defective hygienic conditions, or the subjects of rickets, are least likely to make the favourable recovery generally expected in uncomplicated whooping-cough. Many young infants die from laryngeal spasm, sometimes in the earlier stages of the disease, but mostly in the second stage, when it is readily excited both by pulmonary causes and by bad ingesta, such as bits of orange-peel or other irremovable irritant in the stomach. With good sanitary surroundings and individual care the youngest may escape, unless debilitated by previous illness, such as measles, or a defective state of nutrition, at the time of the attack. The risks diminish with each year of childhood, excepting that the impaired resistance of the chest-walls in rickets may place a child of seven much in the state of another at two or three years old. Constitutional defects, or the accidents of nurture may lead to wasting diseases which begin in the third stage, and prove fatal some time after, or at any age. High fever during invasion is a warning of severe complications in the subsequent stages. Convulsions in any stage of whooping-cough are of the worst significance; somnolence, or a listless condition between the attacks, and persistent high temperature, are bad signs. The danger of the second stage is in proportion to the severity of the spasm. It may be estimated by noting the number of attacks in the twenty-four hours, their intensity, and duration; in bad attacks the expulsive efforts are more rapid, and there is a shrill or repeated whoop; in mild attacks there is less spasm, and the whoop is not always heard, or perhaps only once. The duration may be from a few seconds to some minutes. The number of attacks may be raised from twelve to twenty in the twenty-four hours without danger, if the intervals are complete enough for the child to seem bright and take food in the day, and to get sleep by night; as many as 60 to 80, or even 140 have been counted; they may be so incessant as to interfere with both food and sleep, and are very exhausting. When the nutrition is enfeebled, and the tongue often protruded over the teeth in violent cough, small ulcers are found; they are proofs of the severity of the spasm, and mostly indicative of a danger that is over. Capillary bronchitis and pneumonia are the complications most often fatal; œdema of the glottis or of the lung surely so, but these conditions are rare. Chronic pneumonia is apt to result in dilated bronchi, or in phthisis. Emphysema tends to disappear. Partial collapse may largely recover itself on air regaining admission to the lobule. Blocked alveoli set up a circumscribed pneumonia; their contents caseate; and tuberculosis results from these centres, or from degeneration of the enlarged bronchial and mediastinal glands. Tubercular meningitis and acute tuberculosis during or after the third stage are rapidly fatal.

Treatment.—We have no specific for whooping cough; no drug to check its onset or stop its progress. The disease is of long duration; the patient a child. Hygienic conditions must be observed, and means used to prevent distress, reserving the more active remedies for special occasion. Rest and warmth, with much individual care, and the utmost attention to a sufficiency of pure air, are requisite from the first, and indeed throughout the illness. It is not merely exposure to cold, but fatigue and injudicious food, that determine the accessions of fever so frequent in the course of whooping-cough. These accessions have always with them an increase of the germs of the disease, more as a result than as a cause; they are better lessened or prevented by whatever aids the resisting powers of the child, than by close cosseting indoors, or the use of special germicides, except as a means of freshening the air of the room; an aggravation of all the symptoms follows the confinement of one or two sufferers to a single chamber. The diet is to be light and nutritious, milk forming an important element in the meal, and some addition to the ordinary food has often to be sought, whilst all things hard of digestion or irritating are to be avoided. Broth should be made with vegetables and without condiments; stewed fruit, orange juice or lemon, and grapes are grateful; some extra diluent is always requisite. Each child wants a good deal of help and ready assistance; some one should be near to calm from fright when the cough begins, and to raise and hold the child till the fit is over.

In the *catarrhal stage*, if the ingress be febrile, a day in bed may be right; the child is better indoors till this stage is over; the room must be changed two or three times a day, so that one is thrown open and freshened while the other is occupied, and then closed and warmed, in its turn to be ready for use. Some simple saline, as acetate of ammonia, may be required, or ammonia in any dilute form. A sip

of cold water often relieves cough, but at night some ipecacuanha will be needed; a teaspoonful of the wine, mixed with an ounce or two of sweetened water for the night, can be given by spoonfuls till the cough either lulls or ends in sickness. The bromide of potassium or ammonium in repeated doses, gr. iij–v. to the spoonful of water, gives relief at night in this stage, though more suitable to the next, when antispasmodics, of which chloral is the chief, are most wanted. No form of opium or of belladonna is to be used till the first stage is over, and secretion is free; nor while there is any local congestion or other source of irritation to be removed. A warm poultice of crushed linseed across the back of the chest is often of the greatest use when the cough is teasing, and should always be applied if fine *râles* be heard, or if there be deficient expansion over any part of the lung. The first extension of bronchitis to the finer tubes excites bad spasm, for which a few small doses of any antimonial may be proper, if the child be robust and plethoric. In most cases ipecacuanha can be continued in small doses for some time; the emetic dose at night often soothes by emptying the stomach; this relief must not be sought too frequently, though children's stomachs soon recover from this effect of ipecacuanha after a sleep. The bromides of potassium or of ammonium can be continued throughout all the first and second stages with advantage. A solution of carbolic acid, 2 or 3 grains to the ounce, may be beneficially given to children for several days together at the end of the catarrhal stage, in doses of a teaspoonful to an infant, and a tablespoonful to a child eight years of age, every six hours. The mode of action of carbolic acid is probably very much like that of hydrocyanic acid, once so much recommended in this complaint; it not only lessens spasm, but exerts some influence on the white corpuscles. Some of the soothing effect of spraying this solution of carbolic acid with a small steam vaporizer in a room may be from a part being absorbed. In very many cases no medicinal treatment is needed, but there are others in which the child is obviously ill with more than the usual fever; or, just when amendment is expected and a freer secretion should come on, there is an increase of fever, with no marked complication. In these cases quinine should be given; one grain *per diem* in powder for each year of age, continued for two or three days only, answers best; double this quantity at a single dose, and that repeated, has been given with good effect during the first four or five days of the spasmodic stage. The power of quinine in opposing the pyrogenic force of infection may be exercised through the white corpuscles, as explained by Binz; it has been proved to control reflex excitability. Some priority in the use of quinine and of chloral may be claimed by the writer, in *Temperature Observations in Whooping Cough*, published twelve years ago. Six grains of quinine given to a boy 4 years old, in the afternoon of March 27, 1869, reduced temperature 3° in a few hours. A girl, 5 years old, took thirty grains of chloral on April 12, 1870, in three doses with relief to spasm. The usual dose of chloral required by children is one grain for each year, given two, three, or four times in the twenty-four hours, in proportion to the frequency and severity of the spasm. One great advantage in the use of both these remedies is that they can be given in enemata, either nutrient or stimulant.

Relief of spasm is the main object of treatment in the second or *spasmodic stage*, the efficacy of the means employed being measured by the diminution in the number of daily attacks. By this test belladonna comes next to chloral, if given in large and continued doses; with a child of three years old, $\frac{1}{6}$th to $\frac{1}{4}$th a grain of the extract, or 10 to 15 minims of the tincture, is reached before the pupil is dilated; atropine divided into doses of $\frac{1}{80}$th or $\frac{1}{100}$th of a grain with sugar of milk, or drop doses of the sulphate in solution, is a more certain way of getting the effect required, and regulating the quantity necessary to produce it. Minute doses of morphia, $\frac{1}{60}$th of a grain given with the atropia, or small doses of any opiate with belladonna, answer better than if given uncombined; but this addition is only permissible when the secretions are free, and the means of relief do not require frequent repetition; it is specially useful near meals, when food is ejected with the cough. Oxalate of cerium, 2 or 3 grains for children, 10 grains night and morning for older persons, is of use here; or strong coffee given after meals. The liquid extract of ergot, one drachm a day, given in divided doses to children for two or three days, is said to control spasm. Conium reduces spinal irritability; a lozenge made with one grain of the extract, one-sixth of a grain of ipecacuanha, and one-sixtieth of a grain of morphia, mixed with powdered sugar or treacle, can be given in the earlier spasmodic attacks of cough with advantage. A child of three years old can take three or four of these in one day without nausea. Ten minims of the succus conii are equal to one grain of the extract. The tincture is equally active. Hydrobromate of conia, $\frac{1}{12}$ grain for a child, has been given. The inhalation of ether, ethyl-bromide, or of chloroform is not suitable for children. Croton-chloral, in doses half those of chloral, one or two grains in weak solution, or disguised in powder, given to children three or four times a day, lessens the force and frequency of the spasm. Bromide of ammonium is often all that is required, but nothing is so efficacious as chloral hydrate. Most of the remedies vaunted for cure of whooping-cough owe their repute to having been administered in the fifth or sixth week of illness, when other agents are said to have failed, and the disease is nearly over. Frictions across the back and chest with an oily liniment, to which oil of amber is often added, or with belladonna and opium liniments combined, are useful. Spinal friction, or repeated use of a narrow poultice with a little mustard along the spine every night to cause temporary redness, has seemed to be of service. All the more potent means of counter-irritation, croton oil, blisters, and mustard poultices, are to be avoided, as well as leeches to the head.

In the *third stage* of whooping-cough some astringents are often of great use; and restorative means are much wanted. Alum is of decided benefit when excessive secretion is

troublesome. So is tolu or ammoniacum. Tannin, and also oil of turpentine are used. Zinc in small doses is useful. One or two grains of the oxide may be given three or four times a day in powder, or half a grain of the sulphate in solution. An emetic may be required, to remove excess of mucus; zinc can at this time be added to the ipecacuanha, which alone is best for the earlier stages, when emesis is more often required. Purgatives are at no time advisable. A drop of laudanum before food stays sickness. The mineral acids make an agreeable aid to digestion. Bark or iron may be required, and cod-liver oil. Minute doses of arsenic with meals, and iodine externally over small spaces on alternate days to back and front on either side, counteract obstinate adenopathy. Change of air has a remarkable effect in restoring appetite, and removing spasm, after the disease is quite over; it should not be sought before six weeks, and is often better deferred till two months from the commencement of illness. If the tubercular diathesis have been set up or evoked, the greatest care in nursing, and the most perfect quietude, are essential. Great risks, without benefit, have been run by taking children to gasworks during the course of the complaint. Attempts to cut short the disease by inhalation or insufflations of germicides fail. A weak spray of carbolic acid in the room, or a solution of it, or of peroxide of hydrogen, on cloths or near the child's couch, or sprinkled about, do good by purifying the air.

W. Squire.

**WIESBADEN, in Germany.**— Thermal salt waters. *See* Mineral Waters.

**WIGHT, Isle of.** *See* Undercliff; Ventnor; and Climate, Treatment of Disease by.

**WILDBAD, in Germany.**—Simple thermal waters. *See* Mineral Waters.

**WILDUNGEN, in Germany.**— Earthy waters. *See* Mineral Waters.

**WINDPIPE, Diseases of.** *See* Larynx, Diseases of; and Trachea, Diseases of.

**WINKING, Involuntary.**—Synon.: Nictitation. *See* Facial Spasm.

**WINTER-COUGH.** — This expression is associated with those cases in which a patient is subject to more or less cough during the winter season, being free, or almost free, during the warmer portion of the year. It may come on at any period in the course of the winter, and is generally referable to some obvious cause, which produces 'a cold.' The attacks tend as a rule to become more aggravated and difficult to cure, as well as more easily excited, as time progresses. There is no valid reason why cases of winter-cough should receive any special designation. At any rate this should not prevent them from receiving due attention, instead of being summarily dismissed as mere cases of 'winter-cough'; and it is important in every instance that satisfactory investigation should be carried out, so that the exact conditions which produce the cough may be determined, and the proper treatment pursued which these conditions indicate.



Without entering into details, it may be stated that cases of winter-cough belong chiefly to the following classes:—1. Not uncommonly it is merely due to a slight catarrh, affecting the throat and main air-passages. 2. Most frequently the cough depends on bronchial catarrh or bronchitis in various degrees, usually associated with more or less emphysema. 3. Winter-cough may characterise some chronic phthisical cases, this symptom subsiding during the warmer season. 4. There are certain forms of cardiac disease, of which winter-cough may be a prominent phenomenon.

Treatment.—The treatment of winter-cough must depend on the nature of the cause which gives rise to it, and will be found discussed in the special articles descriptive of the several conditions.

Frederick T. Roberts.

**WOMB, Diseases of.**—Synon.: Fr. *Maladies de l'Utérus*; Ger. *Krankheiten der Gebärmutters.*

There is probably no department of practical medicine in which more progress has been made within the last twenty years, than that comprehended under this article; and it was only after the invention of exact methods of physical examination, such as the speculum and the uterine sound, that its advance towards the prominent position it now holds commenced. Indeed until these came into use the gynæcologist was much in the same position, with regard to diseases of the uterus, as the general physician with regard to diseases of the chest before Laennec's immortal discovery. In the one case, as in the other, the practitioner had of old to trust to general symptoms only, and these were very apt to mislead. As it is only by an accurate examination of the uterine organs that any certain knowledge of their condition can be acquired, the method of making this forms an essential preliminary to the study of uterine disease.

**Methods of Physical Examination.**— 1. *Digital Examination.*—Of all methods of examining the uterine organs, the most important is by the finger alone, nor is the necessary *tactus eruditus* by any means easy to acquire. In this country the lateral position is generally adopted, and, except under special circumstances, is preferable, as involving less exposure than the dorsal. The patient should lie on her left side, with her hips as near the edge of the bed as possible. The semi-prone position is the most convenient, the patient lying more or less on her face, her knees being flexed, the upper one more so than the lower. A good position much facilitates a complete examination of the pelvic cavity, and attention to these details is never superfluous. The index finger of the right hand is now carefully introduced, at first in the axis of the vaginal outlet, and then in that of the pelvic brim. The unimpregnated uterus is suspended, as it were, at the top of the vaginal canal, with the cervix projecting into it. The latter is the part of the uterus which the finger first reaches. As the normal direction of the uterus corresponds with the axis of the upper part of the pelvis, or, roughly speaking, with a line extending from the umbilicus to the coccyx, the cervix, in a

healthy state, projects into the vagina, and points backwards towards the sacrum. Its shape varies in women who have had children, and in the unmarried or nulliparous. In the latter it is conical or nipple-shaped, and the opening of the os uteri is felt at the apex of the cone, as a circular aperture about the size of a pea. The anterior and posterior boundaries of the os uteri are known as the lips of the cervix, and they are very liable to alterations in size, becoming congested or enlarged under various morbid states, one often to a greater extent than the other. In women who have borne children the shape of the cervix is altered, and it becomes shorter and less regularly conical. The os is also changed from a circular opening into a transverse fissure, which is often more or less nodular and irregular at its edges, from lacerations of its tissues during labour; and is sometimes sufficiently open to admit the tip of the finger. When healthy, the mucous membrane covering the cervix is smooth and velvety to the touch; and through the speculum it is seen to be of a uniform rose-pink colour. Under various morbid conditions it becomes rough, granular, stript of its epithelium, and covered with hypertrophied papillæ, and these alterations are of much importance from a diagnostic point of view. Having ascertained the conditions of the cervix, paying particular attention to its size, shape, density, sensibility, and to the shape of the os uteri, we may next proceed to examine the body of the uterus, passing the finger for this purpose past the cervix into the vaginal *cul-de-sac* behind, in front, and on either side of the uterus. In this way we feel whether the uterus is of normal size, or hypertrophied, as it often is; whether it is painful on pressure, or not; whether the uterus is freely movable by the finger, as it ought to be; or whether it be fixed and immovable in any part of its contour, as is often the case from inflammatory adhesion in its vicinity. Then again, in the same examination, we ascertain if any swelling exists in any of the vaginal *culs-de-sac*, in front, behind, or at either side; and if so we try to determine its form, density, mobility, sensibility, and whether it is attached to the uterus, or is independent of it—all points of importance in arriving at an accurate diagnosis.

2. *Palpation.*—In this part of the examination we may often gain much assistance by combining *abdominal palpation* with vaginal examination. This method of bi-manual examination is always of great utility, and is sometimes indispensable for accurate diagnosis, and it is not so generally practised as it ought to be. It may be used to some extent while the patient is still lying on her side, the left hand being passed over her right hip. But to practise it thoroughly we must make the patient turn over on her back, and then by pressing down the abdominal parietes with the left hand, and acting in concert with the examining finger, we may thus thoroughly explore the pelvic cavity, and ascertain much more completely the form and relations of any tumour within it, than by vaginal examination alone. In some cases valuable information can be obtained by a rectal examination, especially when there is a swelling or tumour in Douglas's pouch, or attached to the posterior part of the uterus, which may often be more accurately examined in this way than *per vaginam*. Simple abdominal palpation is often necessary in investigating the nature of any tumour supposed to be uterine. This is best used by laying the patient on her back, with her knees elevated, so as to relax the abdominal parietes. Percussion may often be advantageously combined with palpation. By using one or two fingers of the left hand as a pleximeter, and percussing with the right, we get a dull or tympanitic sound. If the latter is marked where there is much abdominal distension, we know that it indicates bowel distended with gas, and that there is probably no tumour. If there be dulness we can limit its area, and thus verify the results of palpation by mapping out abdominal swelling met with. By these means also we discover the existence of fluid, either free in the abdomen, as in ascites, or contained in an ovarian cyst, the presence of fluctuation being often very readily determined.

3. *Use of the Speculum.*—We now proceed to consider the means at our disposal for examining the lower segment of the uterus with the eye; and from the re-invention of the speculum by Recamier, in the early part of the present century, we may date the commencement of the accurate study of uterine diseases. Numerous varieties of specula have been used. One very generally employed is Cusco's bi-valve speculum (fig. 134). This has the advantage of

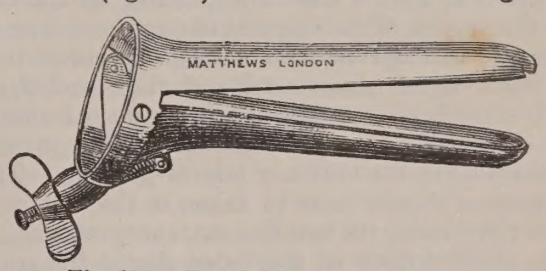


Fig. 134. Cusco's bi-valve speculum.

being easy to introduce, and of being adapted for either a capacious or a narrow vagina. It exposes the cervix well. The objections to it are its expense, and the fact that the metal is apt to be affected by various applications made to the cervix. Personally the writer prefers the tubular (Fergusson's) speculum (fig. 135) made

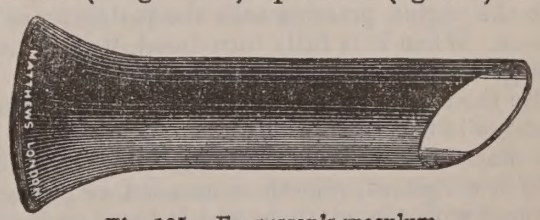


Fig. 135. Fergusson's speculum.

of glass, and covered with caoutchouc; and that which is bevelled at the end is the easiest to introduce, and the best to expose the cervix. For cleanliness and brilliancy of illumination nothing can equal it. It is unaffected by any remedy used for local application, and has the advantage, which is wanting in all other specula, of embracing and steadying the cervix. In certain cases requiring local medication this is of great value. The objection to this form of speculum is its fragility, and the necessity of having instruments of various sizes, adapted to vaginæ

of different dimensions. Practitioners, therefore, at a distance from surgical-instrument makers, will do well to provide themselves with the more expensive instrument. Another form of speculum much used of late years, and in some cases superior to all others, is the 'duck-bill' speculum (fig. 136). This acts on the principle of drawing aside the perinæum and posterior vaginal

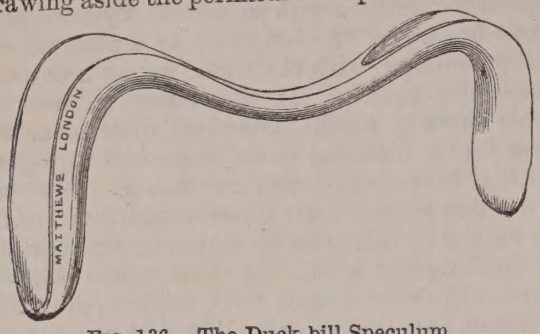


FIG. 136. The Duck-bill Speculum.

wall, so as to allow air to distend the canal, and thus expose the cervix. For certain operations it is invaluable, and is most valuable even in ordinary examinations if the practitioner be skilled in its use. Considerable practice is required, however, to employ it satisfactorily, and it has the further drawback of necessitating the assistance of a second person.

The passing of a speculum, without pain, is an operation requiring some little practice to perform skilfully. In using a tubular glass speculum we must first choose one corresponding to the size of the vagina. This is a point of some importance; for the attempt to pass a large speculum into a small vagina causes much suffering; and if, on the other hand, too small an instrument be used, the cervix is not properly exposed. The patient should lie in the ordinary lateral position. The speculum should then be taken in the hollow of the right hand, its bevelled extremity resting on the under surface of the index finger, the point of which should project a little over its edge, so as to guide it through the ostium vaginæ. The point of the finger having been inserted into the vagina, the mouth of the speculum, the centre of which is grasped gently by the other fingers of the right hand, is held by the left hand, and the instrument, guided along the under surface of the right index finger, is gently insinuated into the vagina, pressing back the perinæum as it enters. When it is fully introduced, it is turned gently round until the cervix is well exposed.

By the speculum we can speedily recognise any changes in the cervix and os uteri; we can see if the mucous membrane covering the former be pale or congested, smooth or abraded, or perhaps covered with granulations which bleed on being touched. The character and amount of discharge should be noted, and it may be wiped away with cotton wool held in the speculum forceps. If the discharge come in great measure from the interior of the cervix and body of the womb, it is glairy, transparent, and very tenacious, and it may often be seen oozing out of the os uteri like white of egg. This is a certain sign of some morbid state of the mucous lining of the uterus. If the discharge come from the surface of the cervix it is yellow and purulent in appearance. We can also recognise any abnormal growth that exists about the cervix, as, for instance, small gelatinous polypi which have evaded the sense of touch.

4. *Examination with the Sound.*—In certain cases in which more accurate information regarding the state of the uterus is required, other accessory means of examination are used. One of these is the uterine sound (fig. 137), by means of which we can explore the interior of the uterus, measure its length, ascertain its direction, &c. The instrument is a thin rod of flexible metal, which can be bent into any desired shape, as it is sometimes necessary to adapt it to the altered curve of the uterine cavity. Its length is divided into inches by means of small notches in the metal, and at two and a half inches from its point is a small knob, indicating the normal length of the healthy uterus. In introducing the sound, the index finger of the right hand is passed into the vagina until its tip rests on the opening of the os uteri, which can be felt as a dimple or depression at the extremity of the cervix. The handle of the sound being lightly held in the left hand, its point, previously warmed and oiled, is guided along the palmar surface of the index finger of the right hand, until it enters the os uteri. It is a good plan to pass the sound through the vagina with its concavity looking towards the perinæum, and after it has entered the os, to turn it gently round, so that its further progress may be in the ordinary direction of the uterine cavity. It is now gently pushed on, no force whatever being used, until its point is arrested by the fundus uteri. The tip of the right index finger is now placed at the os, and withdrawn in contact with the sound, so that the exact length to which it has entered may be ascertained. Considerable practice is required to pass the sound easily and without pain. Gentleness is necessary above all, and the sound should be coaxed to pass, being withdrawn if any resistance is met with, and never pushed on by force. Sometimes the sound will not pass in the ordinary direction, and then an endeavour must be made to adapt it to the curve of the uterine cavity, by bending it, or by passing it with its concavity backwards, as in the cases of retroflexion. The kind of information to be derived from the use of the sound will be best appreciated when treating of the separate diseases of the uterus.

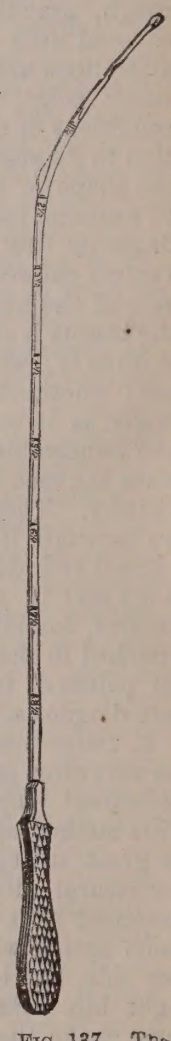

FIG. 137. The Uterine Sound.

5. *Dilatation of the Cervix.*—Another mode of examination, sometimes of much use, is the dilatation of the cervix by sponge or laminaria tents, so as to admit of the introduction of a finger and complete exploration of the uterine cavity. This is of immense service in cases of profuse menorrhagia, when the existence of an intra-uterine polypus, or portion of retained placenta, is suspected. The tent is a mass of

compressed sponge, or a cylinder of laminaria digitata, sufficiently small to enter the cervix, where it swells by the imbibition of moisture, and, in doing so, expands the surrounding tissues. The best way of effecting the desired object is by passing side by side into the cervix a bundle of laminaria bougies, sufficiently long to reach the fundus. These, if left *in situ* for twenty-four hours, dilate not only the cervix, but the whole uterine cavity, and admit of its being thoroughly explored under an anæsthetic. In order to effect this early, the cervix should be exposed by a duck-bill speculum. Dilatation of the cervix is an operation that should not be undertaken without due consideration, as it is occasionally followed by considerable irritation.

**General Ætiology and Pathology of Uterine Disease.**—Much as is the attention which has been paid to uterine disease of late years, the opinions of the profession are as yet far from being decided on many elementary facts connected with it. It is beyond doubt that in this class of disease there are a series of symptoms common to all cases alike, such as pain in the lower part of the abdomen and back, inability to walk, leucorrhœal discharge, and disordered menstruation. If, however, modern writers on gynæcology are consulted, it will be at once seen how various and irreconcileable are the explanations given of these symptoms. Thus we have a school who teach that in inflammation and congestion, either of the cervix alone, or of the body or lining membrane of the uterus, we have the key to uterine pathology, and that all other changes detected in the uterus, such as displacements or flexions, are merely secondary results of the primary affection. On the other hand, there are many influential gynæcologists who refer all uterine disease to mechanical causes; who consider displacements to be the primary cause of nearly every morbid state of the uterus, inflammation and congestion being merely secondary results; and who naturally limit their treatment to an endeavour to replace and support the uterus in its normal position. The want of sufficient pathological study of morbid states of the uterus accounts for these varying opinions, which are much to be regretted; for, while one set of theorists apply themselves to an endeavour to relieve the inflammatory symptoms they find, and which undoubtedly generally exist, by leeches, rest, and suitable local applications, they are apt to undervalue and neglect the mechanical means by which the displaced organ may be supported and steadied, on which their opponents too exclusively rely, but the real value of which it is impossible to call in question. Hence it follows that these partial and one-sided views lead to neglect of really important measures in one direction or the other, and an amount of uncertainty in the mind of the profession which materially impedes a due recognition of the true importance of uterine disease. The fact, no doubt, is that neither of these opposing views is entirely right, but that there is a large measure of truth in both. Of the importance of inflammatory conditions no one, who impartially studies the clinical history of cases coming under his care, can entertain any reasonable doubt. The large, tender, and congested uterus, with its thickened and hypertrophied walls, the inflamed and granular mucous membrane covering the cervix, and pouring out abundance of morbid secretion, are conditions too obvious to be overlooked, and which are very frequently indeed associated with displacements, resulting from alterations in portions of the hypertrophied and over-weighted organ. In some of these cases treatment directed to the original inflammatory condition may, of itself, suffice to effect a cure; in others this fails, unless attention be at the same time paid to the secondary displacements. On the other hand it is equally impossible to ignore the occasional remarkable influence of a simple displacement in producing disease. Who, for example, that has witnessed the long chain of distressing symptoms following a traumatic displacement, such as retroflexion from a fall, and the instantaneous relief sometimes following the introduction of a suitable pessary, can doubt this? In fact all these conditions act and re-act on each other, and too excessive attention to one set of symptoms, based on theoretical dogmas, is as fallacious in uterine as in all other forms of disease.

The causes of uterine disease are very numerous. Among the most common may be mentioned errors in the mode of life consequent on the habits of modern society, such as tight-lacing, want of proper exercise, heated rooms, imprudence during menstruation, and the like. By far the most prolific source of uterine disease is to be found in the changes in the uterus consequent on parturition. Many accidental circumstances are apt to check and arrest the fatty degeneration of the hypertrophied muscles, which normally occurs after delivery. Hence the uterus remains large, congested, heavy, tender, and in the condition known as sub-involution, its cavity, as measured by the uterine sound, being elongated. In such cases the symptoms of uterine disease creep on insidiously after abortion or child-bearing, and, in a large proportion of cases, it will be possible to trace its origin to this source.

In considering the diseases of the uterus, it will economise space if we divide them into four classes, namely:—

1. **Inflammatory and congestive diseases,** with their results.
2. **Displacements.**
3. **Malignant diseases.**
4. **Tumours.**

1. **Inflammatory and Congestive Diseases.** Under this heading we may consider together those morbid states of the uterus, which are variously described under such terms as *acute* and *chronic metritis*, *chronic parenchymatous metritis*, *areolar hyperplasia*, *acute* and *chronic endo-metritis*, *endo-cervicitis*, *chronic uterine catarrh*, *granular degeneration of the cervix*, *ulceration of the cervix*, *congestion of the uterus*, and others.

This course involves the disadvantage of describing together diseases which, whilst they are very generally associated, and have much that is common in their symptomatology and treatment, may often, on the other hand, repeatedly occur, and require important modifications in their management, according to the particular parts of the uterus affected. It is impossible

however, in so short an article, to discuss their individual peculiarities, as would naturally be done in a systematic treatise.

*Acute* inflammatory affections of the uterus, whether of its body or of its lining membrane, are of comparatively rare occurrence when unconnected with the puerperal state, and if a contrary opinion is expressed in many of our gynæcological works, it is probably because various other inflammatory diseases, especially localised inflammations of the peritoneum and cellular tissue near the uterus, have been confounded with inflammations of the uterus itself. No practical harm will result, therefore, if we limit ourselves to the consideration of the more *chronic* conditions which are of such common occurrence, and produce such important consequences. One of the most common is undoubtedly congestion of the uterus, associated with enlargement of its vessels, and very often leading secondarily to more important and lasting disease, such as inflammation of its lining membrane, and the condition described as *areolar hyperplasia* or *chronic parenchymatous metritis*.

Ætiology and Anatomical Characters.—The causes of such congestions are very numerous, and indeed they occur normally in connection with every menstrual period, and may readily be perpetuated. By far the most important, however, is some interference with the proper involution of the uterus after delivery or abortion, to which a large proportion of such disease may be traced. If such congestion continue to be repeated, whatever be its cause, it very often leads to inflammation of the mucous membrane lining the cervix or body of the uterus; and then the diseases known as *endo-metritis* or *endo-cervicitis* are established, which are of much importance. In these the largely developed glandular structures of the mucous membrane are the parts chiefly involved. On microscopic examination they are found altered in character, dilated at their mouths, and pouring out abundantly the transparent spongy mucus which is so characteristic of these affections. The villi of the cervix, both those within the canal and in its exterior, become altered, stript of their epithelium, and eventually hypertrophied. These enlarged and abraded papillæ on the surface of the cervix, when seen through the speculum, form the characteristic red, strawberry-like, abrasions round the os, which, under the name of ulceration, have formed so fruitful a subject of controversy in uterine disease. The detection of this condition—which is in no sense of the word an ulceration, since the epithelium is the only structure destroyed—is of much importance from a diagnostic point of view, but chiefly as leading to a knowledge of the more deep-seated changes which have produced it as a secondary result, which are themselves beyond the sphere of observation, but which are truly at the root of the evil. Hence the granular and abraded state of the cervix must be looked upon as a mere indication of disease elsewhere, not as being in itself a primary disease. Moreover, it is to be noted, as specially pointed out of late by American gynæcologists, that many apparent abrasions of the cervix are really due to laceration of its tissue, and eversion of its altered lining membrane, a condition which can only be satisfactorily made out when the duck-bill speculum is used.

In more advanced stages of these inflammations of the mucous membrane deeper-seated alterations occur. The glands become obliterated or atrophied, and sometimes undergo cystic degeneration; and the whole mucous membrane may become adherent, stript of its epithelium, covered with granulations, or finally converted into a layer of connective tissue covered with polymorphous cells (Klebs). In no long time, moreover, other morbid states of the uterus are developed. The organ becomes enlarged, tender to touch, and very often there is more or less forward or backward displacement. The cervix especially is apt to be hypertrophied, the os patulous, much leucorrheal discharge is present, and all the distressing chain of symptoms accompanying confirmed uterine disease is established. Pathologically, this enlarged and tender state of the body and cervix of the uterus is, by most recent writers, believed to depend on excessive growth of the connective tissue, associated with vascular hyperæmia and hyperæsthesia of the nerves. It should be remembered, however, that it is identical with the condition commonly described as *chronic metritis*, the essentially inflammatory origin of which has long been an axiom in gynæcology.

Symptoms. — The symptoms accompanying these morbid states of the uterus are, in a great measure, those which are common to a large number of uterine complaints. Pain in the lower part of the abdomen and back, increased by exercise of any kind; pain in defæcation or micturition, and in married women, on sexual intercourse; profuse glairy, tenacious, or purulent discharge, in old-standing cases very abundant; disordered menstruation, either scanty or irregular, or more often profuse, and frequently very painful; and, eventually, if the true character of the disease be not recognised, a long and distressing catalogue of general symptoms, such as dyspepsia, hysteria, sickness or vomiting, headache, and others too protean in their character to be described, are among those which are most commonly observed.

The conditions met with on physical examination vary with the duration and extent of the disease, and the tissues of the uterus chiefly implicated. In the simpler cases the uterus is merely somewhat heavy and enlarged, and tender to the touch. When there is endo-metritis or endo-cervicitis to any extent, the cervix is somewhat puffy and enlarged, and the external os patulous, so that the sound passes easily; and, in the same way, a dilated state of the cervical canal and internal os is recognised. Very generally also the surface of the cervix is rough, granular, and greatly abraded, bleeding on being touched, while strings of the characteristic gelatinous discharge are seen to exude from the cervix, and the cervix may be extensively fissured. Lastly, on bi-manual examination, in the more chronic and confirmed cases, the whole uterus will be found to be distinctly enlarged, probably somewhat elongated when measured by the sound, and very commonly the subject of some of the forms of displacement to be presently described.

Prognosis.—The prognosis of these diseases

must, of course, depend on their extent and duration. In their earlier stages they are readily susceptible of improvement and cure. In old-standing cases, which have lasted for years, and produced all the local and general results above described, the treatment is surrounded with difficulties, and the prospect is far from encouraging. It is of such states that Scanzoni speaks when he says: 'We do not remember a single case in which we have cured an abundant uterine leucorrhœa of several years' standing'—a dictum which was doubtless true with reference to the methods of treatment generally employed, but which fortunately cannot be endorsed by those who have employed more radical means of cure, applied directly to the seat of the disease.

Treatment.—The treatment resolves itself into *general* and *local*. With regard to the former, the indications are to do all in our power to improve the nutrition and general health by ordinary means of treatment, such as attention to diet, fresh air, and the administration of appropriate remedies, amongst which such drugs as quinine, small doses of arsenic or strychnia, various ferruginous preparations, and bromide of potassium, either alone or in combination with other remedies, especially when there is much nervous irritability, are amongst the most generally useful. In old-standing cases resort to some of the Continental watering-places is occasionally of much service. These points, however, all depend on general principles, and cannot be further dwelt upon. Among the local measures one of the first and most important to attend to is *rest*. If moving about produce pain, repose in the recumbent attitude ought certainly to be enforced, and in recent and acute cases, it should be absolute. In chronic cases continuous rest leads to the evils of deterioration of the general health, and the risk of acquiring habits of chronic invalidism. This must, then, be decided by the exigencies of the particular case, and the judgment of the practitioner. Generally, some daily gentle exercise, short of fatigue, should be advised, such as walking a little distance, driving in an easy carriage or bath-chair, or sitting in the open air. We may safely assume that exercise which does not produce or increase pain is doing good.

In cases of simple hyperæmia, especially when not of old standing, and when the uterus is tender to the touch, the local abstraction of blood is often of marked benefit. This may be effected either by applying from two to four leeches to the cervix through a cylindrical glass speculum, or, still better, by puncturing the cervix with a scarificator made for the purpose. Another very effectual means of relieving congestion and tenderness of the uterus, is the use of pledgets of cotton wool, to which a string is attached, thoroughly soaked in glycerine. If one of these is introduced into the vagina at night, and removed by means of the string in the morning, it will be found to produce an abundant watery discharge which saturates the linen of the patient. Great relief is thus given, and there is hardly any form of congestive uterine disease which is not benefited by this treatment, which most women can apply for themselves. The glycerine pledgets may be used every night, and they do not interfere with other modes of treatment. Continuous irrigations of hot water at 110°, night and morning, are also most serviceable, but to be of use not less than from one to two gallons must be used, with a suitable cistern syringe. When properly applied these give immense relief. When the uterus is enlarged as well as tender, much benefit may be derived from the application of a pledget of iodised cotton to the cervix once a week. This should be passed through the speculum, and retained in position by a large pledget soaked in glycerine. It rarely causes pain; if it do, it should be at once removed; and it often remarkably reduces the size of the sub-involuted and hypertrophied womb.

When there is evidence of endo-metritis or endo-cervicitis other treatment is required. Now the desideratum is the application of alterative remedies to the diseased mucous membrane, not with the view of destroying it, but of so modifying its circulation and nutrition as to set up healthy action. The want of success so common in treating these cases may be traced to the fact that remedies have not been applied directly to the interior of the cervix or uterus, but that practitioners have contented themselves with treating the abraded or granular condition of the cervix, thus leaving the real seat of the disease untouched. Of late years much advance has been made, and we need not now talk of these chronic inflammatory affections of the lining membrane of the uterus in the same hopeless strain as before. One of the earliest modes of intra-uterine medication was the injection of fluids into the uterine cavity, such as tincture of iodine, or solutions of nitrate of silver. It was soon found that such injections, when the cervix had not been previously dilated, were apt to be followed by very alarming and dangerous symptoms; and it is now generally admitted that they are inadmissible, unless the cervix has been previously dilated with sponge or laminaria tents. This in itself is a procedure not to be lightly undertaken; and to repeat it frequently for a length of time—as would be essential in the treatment of these chronic cases—would be altogether out of the question. Some other method of attaining the desired object is, therefore, necessary, and this we obtain in perfection in the local application of the desired alteratives on suitable probes covered with a thin layer of cotton wool. By this means we can reach the mucous membrane at any part of the uterine cavity, and apply our remedies to it, without the necessity of any preliminary dilatation. The probes used by the writer are made of flexible metal (fig. 138), attached to a wooden handle, and of such a size that when tightly wrapped round with a thin film of wool, they are not thicker than an ordinary uterine sound. They are covered by teasing out a small portion of wool, which is flattened between the palms of the hands. The probe is then dipped in water, to cause the wool to adhere, and by twisting round the handle, the wool being held between the forefinger and thumb of the left hand, the wool is smoothly and firmly wrapped round it. A little practice enables us to effect this with great neatness. The cervix being generally abnormally patulous, there is no diffi-

culty in passing the probes through the os, previously exposed by the speculum, so as to reach the entire uterine cavity. The writer is in the habit of using a mixture of equal parts of crystallised carbolic acid and glycerine, as a local alterative, than which, he believes, there is no better application. Others, however, employ tincture of iodine, strong solutions of nitrate of silver, or even, as recommended by Courty of Montpellier, pass a solid piece of nitrate of silver into the uterine cavity, leaving it there to melt and flow over the mucous membrane. The writer first swabs out the uterine cavity with one or two probes covered with dry wool, so as to remove the glutinous discharge as much as possible, and then passes in another probe, covered with the carbolic solution, so as to paint over the lining membrane of the cervix and body of the uterus, the external abrasions on the cervix being subsequently swabbed over with the same solution. This rarely gives rise to any pain or discomfort, and may be combined with the other plans of treatment already mentioned. Intra-uterine medication is most useful in the week immediately succeeding menstruation, when the superficial layer of the mucous membrane has been shed. If used too near the advent of the next period it may prove too irritating, and may bring on menstruation prematurely. As a rule, two applications, at intervals of a few days, in the early part of the intra-menstrual interval are amply sufficient, and it may be necessary to continue the treatment for many weeks or months. Should laceration of the cervix and ectropion exist, Emmett's operation of tracheloraphé may be indicated. In very severe and obstinate cases of this kind Recamier used to scrape the uterine mucous membrane with a curette, so as to remove the granulations, especially when there was much metrorrhagia, and where there was reason to suspect the existence of a granular condition of the intra-uterine mucous membrane. The Dublin physicians recommend the application of fuming nitric acid, the cervix having been first dilated with tents. This is a very strong measure, which we would not willingly adopt; but it is only fair to say that in the cases in which the writer has used it, he has found it exceedingly useful. Scraping the uterine cavity with the dull wire curette also occasionally has an admirable result in such conditions, and, so far as the writer's experience goes, this is a perfectly safe procedure. Before concluding this subject, a word of caution is necessary. Valuable as intra-uterine medication certainly is in suitable cases, it should never be rashly or indiscriminately employed, and the writer would strongly insist that, before resorting to it, we should satisfy ourselves that the uterus is likely to bear it with impunity. Whenever, therefore, there is much tenderness of the womb on being touched, even when the case is otherwise suitable, the writer deems it advisable first to remove the congested condition by rest, the local abstraction of blood, the use of glycerine pledgets, hot-water irrigations, and other appropriate means; and, above all, the slightest evidence of any concomitant mischief or irritation, recent or of old standing, in the neighbourhood of the uterus, as shown by tenderness on pressure in the region of the broad ligaments, or fixity of the uterus, should be an absolute contra-indication.

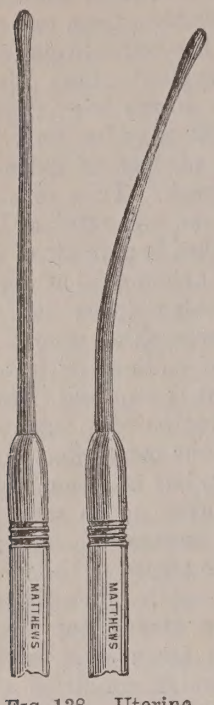

FIG. 138. Uterine Probes.

2. **Displacements.**—Under this head we have to discuss a variety of diseases which have furnished a fruitful theme for controversy among gynæcoolgists. Practically physicians have divided themselves into two great schools with regard to these affections. One of these schools teaches that deviations of the uterus, in whatever direction they occur, whether forwards, backwards, or to either side (for descent of the uterus is of a different character, and must be separately discussed), form of themselves serious maladies accompanied by definite symptoms; and, as a logical deduction, have their treatment primarily in the endeavour to replace the dislocated uterus in its normal position, and maintain its position by mechanical contrivances known as *pessaries*. The other, and perhaps larger, school holds that versions or flexions are not *per se* the cause of the undoubted symptoms which are met with in the cases in which they are found to be present; that flexions may, and often do, exist without giving rise to any symptoms at all; that in all cases the symptoms may be traced to the uterine engorgements and congestions which accompany the deviations, and are their primary cause; and that, therefore, it is unnecessary to pay attention to the displacement, which may be left to itself, while associated conditions are remedied by appropriate treatment. As is generally the case in all such controversies, it is probable that neither side is entirely in the right, and that the truth is to be found between the two. It is certain that in some cases, and under certain peculiarities of constitution, flexions produce symptoms which cannot be explained by the accompanying condition of the uterine structures, which can only be relieved by mechanically supporting the dislocated womb, and frequently are so relieved in the most remarkable manner. It is unquestionable, however, that marked flexions often exist without producing any appreciable symptoms, and as these are only found out accidentally, when, from some other cause, an examination is made, it is not improbable that such cases are much more common than is generally supposed. Upon the whole, the writer is inclined to think that displacements are rather the result than the cause of the associated morbid state of the uterus, and that one of the chief elements of treatment is to get rid of the congested, hypertrophied, or sub-involuted state of the organ which produces them. But even if this be admitted, it by no means follows that proper mechanical support is not needed. So far from this

being the case, the writer believes it to be of the greatest possible value in supporting and steadying the overweighted and misplaced organ, thereby facilitating the removal of its morbid states, as well as relieving its most urgent symptoms.

Properly speaking, displacements of the uterus should be divided into two classes, *versions* and *flexions*. In the former the body of the uterus retains its normal shape, but not its normal direction, the entire organ being displaced either forwards (*ante-version*), backwards (*retro-version*), or to one side (*latero-version*). In the latter the shape of the uterus is altered, and its body is more or less acutely bent over the cervix in the form of a retort, producing the analogous conditions of *ante-flexion*, *retro-flexion*, or *latero-flexion*. But these states are very closely related to each other. Very often they are combined, they arise from similar causes, and they produce similar results. For the sake of brevity, therefore, they will be discussed together.

Ætiology and Pathology.—In order to understand how uterine displacements are produced, it is necessary to remember the means by which the uterus is maintained in its natural position. In the healthy state the uterus is situated high in the pelvic cavity, its fundus projecting somewhat above the plane of the pelvic brim, to the axis of which—that is, to a line drawn from the umbilicus to the coccyx—its own axis corresponds. It is maintained in this position partly by the muscular column of the vagina below, on which it is, as it were, poised; partly by the folds of the peritoneum forming Douglas's pouch behind, especially that portion of them called the utero-sacral ligaments; and partly by fibrous portions of pelvic fascia in front, attached to the pubes and passing by the side of the bladder. These are fixed to the uterus above the points of junction of the internal os with its body, which is, therefore, the part of the organ least liable to change of position, and that at which flexions almost invariably take place. The fundus and body are much more mobile, but their movements are somewhat controlled by the round ligaments in front, and the broad ligaments at the side. The shape of the uterus is further maintained by the well-marked inherent rigidity of its tissue, and when this is altered by disease, or by congestion, sub-involution, and the like, displacements are much more apt to occur. The axis of the uterus is naturally apt to alter its position under various conditions. Thus it falls less or more forwards, according as the bladder is distended or otherwise. The uterus is also so placed that it ascends or descends with more or less freedom, and, as it does so, its axis corresponds with the axis of the plane of that part of the pelvis in which it lies. This fact has been especially pointed out by the late Dr. Squarey, and it goes far to explain why similar causes should at one period produce a forward, and at another a backward, displacement. The causes of displacements are chiefly any conditions which weaken the supports, or the resisting power, of the uterus. They are, therefore, most frequently found in association with the results of parturition, sub-involution, congestion, hyperplasia, and endo-metritis, which all diminish the inherent tonicity of the uterine walls, as well as weaken its supports, and prevent its regaining its natural shape when accidentally altered. The displacement itself may be caused or favoured by a variety of conditions, such as blows, falls, tight clothing, fibroid tumours developed in the uterine walls, and many other analogous states. When a flexion has been produced, the venous capillaries at the point of flexion are more or less obstructed, and the return of blood through them hindered, while the arteries continue to supply blood. The fundus, therefore, becomes congested, and subsequent structural alterations are developed. This point has been insisted on by Dr. Graily Hewitt, and there can be no doubt of its accuracy. This explains the fact that, even when flexions are secondary, it is impossible to treat them satisfactorily by general means alone, and that, in course of time, a flexion, originally secondary in its causation, may require to be the chief object of treatment.

Symptoms.—The symptoms of flexion of the uterus are in no way special. They are very much those which have already been described as accompanying the inflammatory varieties of uterine disease, and there are none which would enable the practitioner to foretell its existence with certainty. Amongst those most commonly observed are pain, weight, and bearing down, often decidedly increased by exercise of any kind, not unfrequently rendering locomotion an impossibility; pain in one or other ovarian region; pain, and sometimes difficulty, in micturition; and various disorders of the menstrual function, more especially dysmenorrhœa and menorrhagia. After these have lasted some time the secondary derangements of the general health, so common in uterine disease, become established, and they lead to very serious consequences.

Diagnosis.—The diagnosis of displacements is not difficult on vaginal examination. Supposing we have to do with a flexion, the cervix is found in its normal position; but either in front, behind, or, more rarely, at either side, is a rounded swelling about the size of half an orange, which can be pushed away by the examining finger. This might be confounded with various other conditions, such as small uterine fibroids, inflammatory exudation, hæmatocele, small ovarian tumours, &c. The diagnosis can, however, be readily cleared up by the sound, which will only pass in the direction in which the uterus is flexed; and, on turning it gently and cautiously round, the flexed fundus is lifted with it, and can no longer be felt in its former position. In ante- or retro-version, in addition to feeling the body of the uterus in its abnormal situation, we also find that the cervix is lifted out of its usual central position, and points either forwards or backwards.

Treatment.—In arranging a plan of treatment for uterine displacements, the concomitant conditions should be carefully attended to, and endometritis, congestion, and other complications relieved, if they exist. Unless this is done, the treatment may entirely fail, or may be very unnecessarily prolonged. Here we must limit ourselves to a very brief description of the best plans of mechanical treatment, strongly insisting, however, that they should not be too exclusively relied on. In backward displacements we have a very satisfactory means of supporting the mis-

placed organ in the well-known Hodge's pessary numerous modifications of which exist. The important point to bear in mind is to select an instrument not too bulky, nor too long for the individual case; the best material being either wire covered with soft india-rubber, vulcanite, or Britannia-metal. The treatment often fails from want of proper selection; since a pessary, to be thoroughly useful, should be fitted as accurately as a shoe to a foot. Before introducing it the sound should be gently passed, and the uterus replaced and held in its proper direction for a few minutes; and this manœuvre should be repeated at intervals of about a week, until the uterus does not re-assume its abnormal position. Even then, however, the pessary should be worn continuously for several months, until we feel quite sure that the misplacement is permanently relieved. In many cases relief is instantaneous and remarkable; in others the fundus is too tender to bear the pressure of the pessary at all. When this is the case it should be removed, and an endeavour should be made to prepare the uterus for the use of this support by the local abstraction of blood, hot irrigations, the application of glycerine pledgets, or sedative pessaries. In introducing the Hodge's pessary, care should be taken to guide its upper part into its proper position behind the cervix, so as to press up the fundus; and, as the case improves, a larger instrument should be introduced, so as to follow up the retreating fundus. Reposition of the uterus must, of course, never be attempted if there is reason to think that the fundus is bound down by adhesions, or if the uterus is very tender. In suitable cases, however, it materially facilitates the cure.

Anterior displacements must be treated on the same principles. Unfortunately, we do not possess anything like an equally good means of mechanical support, and a thoroughly efficient ante-flexion pessary is still a desideratum. After trying a good many the writer has come to the conclusion that the best is Dr. Graily Hewitt's vulcanite cradle pessary, of a size suitable to the case. It is, however, difficult to introduce and remove. Nor can it always be borne. A well-fitting abdominal belt—and the best is that known as the American belt—is often of great assistance, by removing the weight of the superincumbent intestines. When all other means of restoring a flexed uterus fail, an intra-uterine stem pessary may possibly succeed. Great caution, however, is necessary, and it should never be used unless the patient is under constant supervision, so that it may be removed on the slightest appearance of undue irritation. During the treatment of all flexions, rest is of paramount importance, not absolute, but as much as possible, and exercise should be very sparingly permitted, and only in a tentative manner.

*Prolapsus.*—The only other displacement of the uterus requiring special mention is descent or *prolapsus*, for the corresponding condition of undue elevation is of little practical importance. Descent of the uterus is far from rare, and it sometimes causes much discomfort. In it the uterus descends from its normal position to a varying extent, so that the prolapsus may be only partial, or it may be complete. When the entire uterus lies without the vulva, along with the everted vagina, the mass is known as *procidentia uteri*.

Ætiology and Pathology.—Descent of the uterus depends upon a variety of causes which lead to a weakening of the uterine supports, either from above or below. These supports are chiefly, above, the various uterine ligaments, with the cellular tissue of the pelvis; below, the muscular column of the vagina. When from any cause, such as imperfect recovery after child-birth, senile absorption of adipose tissue, or rupture of the perinæum tending to prolapse of the vagina, they are no longer able to support the uterus efficiently, a comparatively slight cause may suffice to allow the womb to be pushed or drawn out of its place, as, for example, straining, lifting heavy weights, undue weight of the organ itself, and many other causes. As soon as the organ is prolapsed, to whatever degree this may occur, various morbid alterations are pretty sure to follow. The uterus becomes irritated, congested, and hypertrophied; and the everted mucous membrane of the vagina, which then covers it, becomes greatly altered, and assumes almost the appearance of skin. The most characteristic change, however, is generally elongation of the cervix, through traction from below, especially in cases in which prolapse follows previous descent of the vaginal walls. This elongation is due to yielding of the elastic tissue of the cervix, especially that portion above the roof of the vagina, which becomes greatly elongated, so that the sound introduced into the procident organ may pass for six or seven inches. When the uterus is replaced, the normal elasticity again comes into play, and the cervix rapidly contracts. This is the condition described by Hugier as *hypertrophic elongation of the cervix*, and it is rarely absent.

Symptoms and Diagnosis.—The symptoms of prolapse of the womb are mainly due to the mechanical discomfort attending it, such as weight, difficulty in progression, interference with micturition, and much general inconvenience. The diagnosis is a matter of no difficulty. In the greater degrees the procident organ, covered with the hardened and altered vaginal mucous membrane, is at once apparent. The only condition it is at all likely to be confounded with, is old-standing inversion of the uterus, and from this mistake the presence of the os uteri at the apex of the tumour will at once guard us. In the slighter degrees the cervix will be felt low in the vagina, or even at its orifice.

Treatment.—The treatment comprises two principal indications:-First, rest, and consequent reduction of the size and weight of the procident organ; thereby greatly facilitating the second indication, namely, re-position, and maintenance of the uterus in its normal position. The effect of mere rest in diminishing the size of a prolapsed uterus is often very remarkable. A week or ten days in bed will often, of itself, reduce the cervical elongation to a considerable amount. Re-position is generally easily effected, and the chief difficulty is in support. In devising mechanical contrivances for keeping the uterus in position, the chief thing to bear in mind is that we should strengthen the natural uterine sup-

ports, so that they may regain their lost power of keeping the organ in its place. Hence the old ring or ball pessaries, which greatly distend the vagina, are absolutely inadmissible. In the slighter degrees an ordinary Hodge may answer every purpose, an endeavour being, at the same time, made to give better support from below. This is generally best done by a perineal pad, and also sometimes by using an astringent to the vagina, so as to make it a more efficient column of support, such as alum or oak-bark injections. In the greater degrees the best kind of pessary is that known as the 'vaginal stem,' which is in the shape of the cup of the ordinary toy known as the cup-and-ball, on the extremity of which the cervix rests, the other end being attached to a perineal band. If this does not answer, the pessary known as Swancke's may succeed. This has the advantage of supporting the uterus without unduly distending the vagina. These measures are merely palliative, and a more radical cure may be hoped for by various operative procedures, into the details of which it is impossible to enter. It may suffice to say that they consist of:—First, the removal of a small portion of the elongated cervix, either by the galvano-caustic wire or the écraseur, in the hope of stimulating the remainder to contract, a procedure only occasionally required, but sometimes of undoubted utility. Secondly, the making of a new perinæum, in cases in which the prolapse seems secondary to undue descent of the vagina—a very valuable resource. Thirdly, narrowing of the vagina itself, for which a variety of operations are practised, which, like removal of a portion of the cervix, are rarely required.

3. **Malignant Disease.**—Malignant diseases are of common occurrence in the generative organs of females, and indeed they are more often met with in these than in any other part of the body.

Ætiology.—Malignant disease of the uterus is most common about the middle period of life, the largest number of cases occurring between forty and fifty years of age. Occasionally we meet with rapidly advancing cases in younger women under thirty years of age, or in old women who have long ceased to menstruate. Hereditary predisposition apparently plays some part in its production, but not so much as was formerly believed. Frequent child-bearing has a decided influence in favouring its development, since the proportion of cases is larger in multiparæ. To this may be added any causes of constitutional debility, since it unquestionably occurs more often in weak and unhealthy than in strong and robust women.

Anatomical Characters.—All the recognised forms of malignant disease occur in the uterus, but some of them are more common than others. Scirrhus is that which is least frequently observed, and the medullary carcinoma most often. Klebs, however, has pointed out that in the earliest stages of carcinomatous disease the fibrous element preponderates in the affected part; while, as the malady progresses, cell-growth rapidly advances, so that in old-standing cases, and on *post-mortem* examinations, the medullary carcinoma is that which is found, although, at first, the scirrhous form may probably have existed. Another common variety of malignant disease is the epithelial cancer, which chiefly affects the mucous membrane of the cervix. The so-called colloid cancer is rarely met with. In the large majority of cases the cervix is the part first affected, although, in exceptional instances, the disease may originate in the body of the uterus, the cervix being at first unimplicated.

At the commencement of the more ordinary variety the cervix is hard, somewhat nodular, and hypertrophied. It is comparatively rare for the disease to be seen at so early a stage, and, as the uterus is then quite movable, it is impossible to distinguish it from enlargement of the cervix due to congestive forms of disease. As the disease progresses, the carcinomatous degeneration advances rapidly; more and more tissue is involved; and the roof of the vagina becomes implicated, so that the uterus is fixed in a mass of new growth. Before long a destructive process commences; portions of the growth slough and come away; hæmorrhage takes place from the opening of vessels; and, in advanced stages of the disease, the cervix may be entirely destroyed, and even the bladder or rectum opened, so as to form a common opening with the vagina. The epithelial variety of cancer commences on the mucous surface of the cervix by the growth of its villi into a papillary tumour, which, at first, it may be impossible to distinguish from similar growths of a foreign character. It rapidly spreads however, soon forming a fungating soft mass, not unlike the flower of a cauliflower in appearance, hence its popular name 'the cauliflower excrescence.' As in medullary carcinoma, destructive changes soon occur; ulceration progresses; and, as the disease advances, the neighbouring structures are implicated. When the disease involves the more deeply-seated tissues, *post-mortem* examination shows that the malignant growth there assumes more of the character of medullary cancer.

Symptoms.—The earliest sign that arouses suspicion as to the existence of malignant disease is generally the occurrence of hæmorrhage, at first merely an excessive menstrual flow, subsequently loss of blood, sometimes very great in amount, at irregular intervals. Sometimes it is brought on by trivial causes, and a not unfrequent complaint is that it always occurs after sexual intercourse. Excessive hæmorrhages, which are sometimes very alarming in amount, do not, as a rule, occur until advanced stages of the disease, when destruction of tissue is taking place. Another marked symptom is profuse discharge, often having a peculiar and pathognomonic fœtor, from the admixture of minute portions of sloughing tissue. In medullary carcinoma the discharge is not usually abundant, but it is sometimes very ichorous in character, producing excoriations, intense pruritus, or other disagreeable symptoms, in consequence of its irritating property. In epithelioma it is often very abundant, watery in character, and tinged with blood. Pain is sometimes excessive. The writer has often, however, seen cases terminate fatally without any pain at all. General constitutional disturbance soon results; the peculiar cachexia of malignant

disease is developed; and the patient becomes sallow, emaciated, and extremely debilitated.

Diagnosis.—In advanced cases vaginal examination at once clears up the nature of the case. The cervix and roof of the vagina are infiltrated with the characteristic hard growth, and the uterus is quite fixed. If ulceration has advanced, the ragged broken edges of the cervix are apparent, bleeding on being touched, and breaking down under the finger. In a case of this kind mistake is hardly possible. In the earlier stages, before fixation and ulceration have advanced, error is easy, and it is far from uncommon to find non-malignant alterations of the cervix which have been mistaken for cancer, and even the reverse. Nothing but time will clear up such doubtful cases, and care should be taken not to give a positive diagnosis, unless the character of the case is marked and undoubted. The most difficult cases to diagnose are those in which the body of the uterus is alone affected. Here hæmorrhage, fœtid discharge, and recurrent attacks of spasmodic pain (probably caused by the efforts of the uterus to expel discharge collected in its cavity) may arouse suspicion; but nothing except dilatation of the cervix, and thorough exploration of the uterine cavity, can clear up the nature of the case. On account of the friability of the tissues, this must always be done with great caution. In epithelial cancer the soft, fungating, bleeding, and easily broken-down mass can hardly be mistaken for anything else.

Prognosis.—The prognosis is, of course, most unfavourable. There are, no doubt, a few authentic cases on record in which the patients have recovered after amputation of the cervix, but these are of the utmost rarity. In the vast majority death takes place, in a time varying from a few months to one or two years. Probably the disease advances most rapidly in younger patients, but few last longer than two years. Death takes place either from exhaustion, hæmorrhage, septicæmia, or some other complication. The writer has seen it on one or two occasions result from uræmia, the consequence of occlusion of the ureters through extension of the cancerous growth.

Treatment.—In the large majority of cases seen for the first time at an advanced stage, treatment must, of necessity, be palliative only. Here there are two chief indications—the maintenance of the general health; and the relief of pain, fœtor, or other distressing local complications. For the former we must rely mainly on a suitable diet, and the administration of some tonic which may be found to agree with the patient. The preparations of arsenic, as a rule, answer better then either iron or quinine. For the relief of pain the use of opiates, either in the form of morphia suppositories or administered subcutaneously, must be our sheet anchor, and, when the pain is severe, it may be necessary to exhibit them in large doses. Fœtor may be best arrested by the local use of antiseptics. The plan which the writer has found to answer best for the purpose is to introduce at night into the vagina a pledget of cotton wool, soaked in the glycerine of tannin, to which a small quantity of the glycerine of carbolic acid has been added, in the proportion of about one ounce of the latter to eight ounces of the former. This effectually destroys fœtor, while the astringent property of the tannin serves to check unduly rapid cell-growth, and prevent hæmorrhage. In the morning the vagina may be syringed out with Condy's fluid and water. Iodoform pessaries are also extremely useful for this purpose. When hæmorrhage is excessive local hæmostatics, such as the diluted liquor ferri perchloridi, must be used, and, if necessary, the vagina plugged. Surgical treatment may be adopted, either in the hope of entirely removing the disease, or of lessening the hæmorrhage and discharges, and so retarding its progress. Either indication is most easily fulfilled in epithelial cancer. When this is limited to the cervix, when there is a fair margin of healthy tissue between the diseased portion of the cervix and the body of the uterus, amputation by the galvano-caustic wire or wire écraseur should be resorted to, the actual cautery being subsequently freely applied to the stump, to destroy, as much as possible, any infiltrated cancer-cells. Even when this fails to prevent the recurrence of the disease, it will certainly prolong the life of the patient, and increase her comfort. In other cases destruction of the exuberant growth, both in epithelial and medullary cancer, may be advantageously effected by local caustic applications, such as strong solutions of chloride of zinc, nitric acid, or bromine. Of late years the same object has been sought by excising the diseased tissue, or by scraping it away as much as possible by peculiar scoop-shaped curettes made for the purpose, after which one of the above-mentioned caustics, or the actual cautery, may be applied. It is in the epitheliomatous form of malignant disease that this procedure is most valuable, and a carefully performed operation may prolong life for months or years. The more radical operations for extirpation of the entire uterus, as practised by Freund and Billroth, are too little known to justify discussion in this place. These procedures, however useful they may be in the earlier stages of the disease, are clearly inapplicable when it is advanced, and when the bladder, rectum, or vagina is involved in its spread.

4. **Tumours.**—(1.) *Fibroid Tumour.*—By far the most common variety of uterine tumours—so common that, according to some authorities, it is found in 60 per cent. of women who die after middle age—is the so-called fibroid tumour (myoma, fibroma).

Ætiology.—Fibroid tumours are most common after twenty years of age, and in certain races, the African especially, they occur with great frequency. Beyond this nothing is known of the causes which produce or favour their growth.

Anatomical Characters.—Fibromata are limited hypertrophies of the substance of the uterus, existing in the form of more or less globular tumours, contained loosely in a capsule of fibro-cellular tissue. Structurally they are homologous with the tissue of the uterus itself, consisting of connective tissue, mixed with unstriped muscular fibres. They are found of every size, varying from dimensions scarcely larger than a millet-seed, up to enormous masses weighing as much as fifty pounds. Most generally they occupy the fundus

and body of the womb, and they are conveniently divided into three classes, according to the position they occupy, namely, the *sub-peritoneal*, occupying chiefly the outer surface of the uterus; the *intra-mural*, chiefly developed in the substance of the walls; and the *sub-mucous*, which project into its cavity, and these may be either completely sessile, with a broad base of attachment, or they may have become more or less pedunculated, and then approach in character to the fibroid polypi.

When once formed, the future progress of fibroids of the womb varies much. Generally they are of very slow growth, and, although malignant degeneration of their structure has been observed in rare instances, they most commonly exist for the rest of the patient's life, without giving rise to any troublesome effects, beyond those resulting from mechanical pressure, provided they are not accompanied by hæmorrhage. They are, however, subject to certain occasional alterations, such as inflammation and even sloughing, when mechanically injured, fatty and calcareous degeneration, and even to complete abortion. The possibility of their entire spontaneous disappearance has been strongly questioned. The writer has published several instances coming under his own observation, and the fact is now pretty generally admitted, the explanation probably being that on account of similarity of texture to that of the tissues of the uterus, they are subject to a process of involution like that which the tissue of the uterus undergoes after delivery.

Symptoms.—The symptoms of fibroids of the womb depend to a great extent on their position. The sub-peritoneal and interstitial varieties, when not very large, are often unaccompanied by any symptoms whatever, and those that exist are chiefly the result of mechanical pressure, such as weight, difficulty in walking, irritability of the bladder, constipation, and the like. In the sub-mucous variety, the prominent symptom is hæmorrhage, which sometimes occurs to a very alarming extent, and may even put the patient's life in danger. The source of the hæmorrhage is probably, in the majority of cases, minute capillary vessels in the mucous membrane covering the tumour, which keeps up irritation and congestion in its neighbourhood. It is similar in its origin, therefore, to the discharge in menstruation, and is greatest in amount at the menstrual period. The more severe hæmorrhages are probably caused by openings in various tissues developed in the periphery of the tumour, where the vessels are increased in size, just as they are in pregnancy.

The physical signs vary with the size and situation of the tumours. If large enough to be perceptible on abdominal palpation, they have generally a more or less rounded or lobular outline, and a hard, firm feel, without any fluctuation, which serves to distinguish them from other varieties of abdominal growth. Small tumours, however, growing from the sides of the uterus, may be easily confounded with other conditions, especially flexions of the uterus, and deposits or exudations in its vicinity, such as hæmatocele, or pelvic cellulitis or peritonitis. The mobility of the uterus, which in the latter conditions is generally impaired, and the use of the uterine sound, which shows, in tumours, that the cavity of the uterus is considerably elongated, ought to enable us to avoid such mistakes.

Treatment.—The treatment resolves itself into *medical* and *surgical*. The former may be said to be powerless, all the so-called absorbents—iodides, bromides, preparations of lime, Kreuznach and other waters, being admitted to be of no reliable value whatever. The only plan which merits further study is the subcutaneous injection of ergotine, in doses of from gr. ss. to gr. j. daily, which is said by Hildebrandt to be of great value, and is favourably spoken of by Atthill and other authors. In a case at present under the writer's care, in which hæmorrhage had been continuous for two years, and in which a mass of fibroid reached half-way up to the umbilicus, under the continuous use of this method for several months, the abdominal tumours are no longer to be made out, although those formerly felt in the pelvis still exist, and the hæmorrhages have entirely ceased. In one or two other cases the writer has been obliged to discontinue the treatment, on account of the severe cutaneous irritation the injections produced. Surgical methods of treatment are only called for when the hæmorrhages are excessive and exhausting. To discuss them at length is impossible in so limited a space, and the writer can do little more than merely enumerate them, referring the reader to any recent systematic work for complete details.

*a.* Injection of *styptics* into the uterine cavity, such as tincture of iodine, or diluted tincture of the perchloride of iron, is valuable when the hæmorrhage is excessive, but a plan which should not be tried unless the cervix has been previously dilated.

*b. Incision of the cervix* is decidedly beneficial when the hæmorrhage is frequent and severe, which is supposed to act by allowing the uterine fibres to contract upon the tumour.

*c. Incision of the capsule of the tumour* itself is useful in certain sessile tumours projecting into the uterine cavity, certainly diminishing the hæmorrhage, and facilitating subsequent enucleation.

*d. Removal* of as much as possible of the tumour, with the écraseur or galvano-caustic wire, may be undertaken, when it is so situated as to be within reach.

*e. Enucleation* is very valuable when the tumour is projecting into the uterine cavity, and is already partially separated from its attachments. Under such circumstances, it may be shelled out from its capsule *en masse*. The operation, however, is difficult and severe, and must be reserved for very urgent cases.

*f. Gastrotomy*, with the removal of the mass of the tumour, and even of the entire uterus—is one of the most formidable of all operations, but one which has recently been occasionally successfully performed, and which is justifiable when the patient's life is seriously endangered from uncontrollable hæmorrhage.

*g.* The artificial production of the menopause by *removal of the ovaries* is an operation which has of late been highly recommended.

2. *Polypus.*—Polypus of the uterus may be

considered in connection with this subject, since the large majority of polypi are merely *fibroid* tumours, to a great extent enucleated from their capsules, and attached to the uterus by a narrow pedicle. There are, however, two other varieties described, the *glandular*, and the *cellular* polypi.

Anatomical Characters.—The *glandular* polypus is a localised hypertrophy of connective tissue, rarely larger than an egg, and generally attached to the cervix; the *cellular* is a hypertrophy of some of the glandular structures of the cervix, either of the Nabothian follicles or the utricular glands, and it is generally of small size. *Fibroid* polypi, like fibroid tumours, may be of any dimensions, but they are commonly met with about the size of a small pear.

Symptoms and Diagnosis.—Polypi are only important because of the hæmorrhage which so frequently accompanies them. When extruded from the cervix, or growing from it, they offer no difficulty in diagnosis. Nor is there any condition apt to be mistaken for them, except a chronic inversion of the womb, which can be readily differentiated by tracing the pedicle through the os, and finding that the sound enters the uterus to its usual depth. Intra-uterine polypi are much more difficult to discover, and here the only plan is complete dilatation of the cervix, and thorough exploration of the uterine cavity. This procedure is essential in all cases of severe hæmorrhage resisting ordinary hæmostatic treatment.

Treatment.—When once a polypus has been detected, the only treatment is its removal. In cases in which the polypus is chiefly in the vagina, this is easy enough, the wire of an écraseur being passed round the pedicle, which is separated in this way from its attachment. It is not essential that the wire should touch the base of the pedicle, since the part left, after the bulk of the polypus is removed, always shrivels up and disappears. In intra-uterine polypi it is sometimes difficult to pass the wire round the pedicle, but by thoroughly anæsthetising the patient, and using a single wire, it can generally be managed. No other method of removing polypi is so good. Excision may give rise to hæmorrhage, and the old method of ligature is dangerous from the risk of inducing septicæmia.

3. *Fibro-cystic and Sarcomatous Tumours.*—The only other uterine growths requiring mention are the fibro-cystic tumours (cysto-fibroma, cysto-sarcoma), and the sarcomatous tumours.

The *fibro-cystic* tumour is specially important on account of its great resemblance to cystic tumours of the ovary, and the extreme difficulty of differential diagnosis, which is so great that probably there is no ovariotomist of any experience who has not mistaken the one for the other. The fibro-cystic tumour is a fibroid tumour of the uterus, generally of the sub-peritoneal variety, which has grown to a large size from the development of cysts in its substance. This is most usually effected by degeneration of its tissue, which becomes liquefied and transformed into an albumino-serous fluid. Thus we have a tumour partially solid, partially fluctuating—although rarely so distinctly so as an ovarian tumour—from which fluid can be drawn by an exploratory puncture, and which may obtain dimensions, and produce constitutional effects, not less marked than those of ovarian cystic disease. The differential diagnosis may well baffle even the most expert gynæcologist. The sound may possibly enable us to ascertain the uterine character of the growth, as it enters for a considerable length, and on moving it the connection of the tumour with the uterus may be demonstrated. Athill has recently laid stress on the character of the fluid removed on puncture as diagnostic, since, unlike ovarian fluid, it coagulates spontaneously on standing, and on microscopic examination elongated fibre-cells, similar to those of the uterus itself, are found in it. The prognosis of these growths is unfavourable, since they produce all the evil effects of ovarian tumours, and the risk attending their removal by operation, which is the only available method of treatment, is much greater than that of ovariotomy.

*Sarcomatous* tumours of the uterus have been but little studied. They are in many respects like fibroid growths, but have a marked tendency to fungate and ulcerate, and to return after removal. Hence, they hold a place midway between the benign fibroid and the malignant cancerous growths, and they generally spring from the uterine tissue, like the sub-mucous fibroids, but without any distinct capsule. The symptoms are chiefly those of fibroid in that situation, namely, hæmorrhage; profuse watery discharges, occasionally differing in character; and sometimes pain, probably the result of uterine contractions. The treatment must consist in the removal of as much as is possible of the tumour by the écraseur or galvano-caustic wire; and, if the nature of the tumour be ascertained, its attachment should be thoroughly cauterised with strong nitric acid.

W. S. Playfair.

**WOMEN, Diseases of.**—Synon.: Fr. *Maladies des Femmes*; Ger. *Frauenkrankheiten.*

The intention of this article is to indicate what is comprehended under its title: to define the proper limits of the subject; to show broadly the relations of the subject to general pathology; and to set out some connected points and general principles which could hardly be so usefully stated in the special articles into which the subject is necessarily subdivided.

It is impossible to draw an arbitrary line that shall clearly separate what are commonly regarded as the special diseases of women from the domain of general pathology. The study of the diseases centred in the sexual system of women is no more than the application of general pathology to this particular system. Any disease occurring in a woman will almost certainly involve some modifications in the work of her sexual system. On the other hand, the ordinary or disturbed work of her sexual system will influence the course of any disease which may assail her, however independent this disease may seem to be in its origin. Still, bearing in mind the foregoing fundamental facts, it may be stated broadly that the diseases of women embrace more especially those morbid processes and mechanical deviations of which the principal seat is in the sexual system, that is, in the ovaries, uterus, and breasts. Yet even this is a narrow and misleading

view to take. It is no more possible to imagine an isolated pathology of the ovaries or uterus, than of the liver, kidney, or heart. If any one of these organs be damaged or working imperfectly, the blood, the nervous centres, the other organs, the whole body suffer. No one organ can withdraw itself from its solidarity with the rest. And it is often an impossible task to analyse what appears at first sight to be a simple case, say of disease of the kidney, into its component elements, and to bring home to the kidney the initial fault. The controversy concerning arterial fibrosis, heart-disease, and Bright's disease, is a striking, but by no means exceptional, illustration of this proposition. The same thing is equally true of many apparently special disorders of the ovaries or uterus. The disturbance in function of these organs may be so obtrusively prominent that attention is concentrated upon them ; and thus we may be led to regard them as the exclusive or principal seat of morbid action, and so to expend upon them our remedial care. The physician, in search of a diagnosis, is greatly guided by the observation of function. Disturbed function raises a presumption that the organ disturbed is itself at fault, and we are instinctively inclined to help that organ in its difficulty. But the primary or efficient cause may be elsewhere. This is as true of the ovaries and uterus as it is of the heart, kidney, or any other organ. One illustration will suffice. A woman suffers an abortion. There is the uterus obviously disturbed in its function, acting, in fact, in an improper manner. But we cannot in all cases affirm that the uterus is diseased. The causes of abortion are multitudinous. An efficient cause may indeed be found in some mechanical or structural fault of the uterus ; but more often it will be found in the impeded work of some remote organ, or in an empoisoned state of the blood. Nor is any case often simple. Commonly several causes concur, local conditions acting and reacting upon each other. Thus, when the immediate cause is found in some alteration of tissue in the uterus, we may still have to look for the original cause in some antecedent constitutional disorder, for example, struma or syphilis, inherited or acquired, or perhaps in some long past transient morbid process, whose action can only be traced back—if traced at all—through the fallacious records and conjectures of history. Nor even then shall we be justified in concluding that we have discovered the whole secret of the abortion, that we are masters of the situation, able to take a right view of its clinical significance, and competent to deal with it on rational principles. Abortion is not seldom a conservative process, a remedy adopted by Nature to avert urgent distress in the circulation or in vital organs. There may be no appreciable disease in the uterus or embryo ; but the embryo is cast out, the uterus is emptied, in order to relieve the system of a source of danger. Here, then, is proof of the danger of treating disorders of the sexual organs as a detached bit of pathology.

Here we may make particular application of a general law. The case may be formulated aphoristically. An organ so made to work against obstruction, in excess, or in an unnatural manner, is prone to organic disease. This is remarkably true of the uterus. It may be said indeed that a very large proportion of the structural abnormalities of the uterus arise in this way. Hence the importance of looking at disturbed function, not necessarily as evidence of disease of its correlated organ, but always as a warning that disease of that organ is in course of induction or of aggravation. This applies most strongly to the history of dysmenorrhœa, in which the transition from physiology in difficulty into pathology is often conspicuously manifested.

The widest and perhaps the best definition of the subject is expressed in the word 'Gynæcology.' It embraces indeed far more than is expressed in the term 'diseases of women.' In its full etymological meaning it is comprehensive beyond the strict domain of medicine ; but experience and thought will show that it does not go beyond the philosophical conception of the care of the 'health of women.' Without accepting the doctrine of Michelet, that the life of woman is a history of disease, it is undeniable that to appreciate justly the pathology of woman we must observe her in all her social relations, study minutely her moral and intellectual characteristics—that we must, in short, never for a moment lose sight of those physical attributes which indelibly stamp her as woman, which direct, control, and limit the exercise of her faculties. This collateral study is of infinitely more importance in the pathological history of woman than it is in that of man. A very large, perhaps a preponderating, proportion of all the diseases to which women are subject, arise out of, or are in intimate reactive relation with the play of her sexual system. The key to many of the disorders of woman, especially of the nervous system, will be found here. The essence of her mental life is responsiveness ; the emotional, the reflex, or diastaltic functions play an infinitely more active part than in man. It may further be said that the reciprocal action of the brain and spinal cord and ganglionic nerves is quicker and more intimate than in man, especially that the brain is more strictly subservient to the animal functions. Abstraction from corporeal impulse, initiation, enterprise are masculine faculties.

There is one *primâ-facie* limitation of the subject. The proper diseases of woman occur during her sexual life ; that is, during the functional activity of the ovaries, uterus, and breasts. Before this epoch sets in the female is not a woman but a child; and when this epoch is over, those organs shrivel up and no longer affect the system as before. Practically, however, the physical defects of the sexual organs in course of development, as in girls, and in course of atrophic degeneration, as in old women, are so closely related by continuity of history with their state in the epoch of functional activity, that all three epochs are but linked chapters of the same history. To cut out arbitrarily the consideration of the child and the old woman must needs invalidate our knowledge of the physiology and pathology of the woman proper. But for the gynæcologist this study need not embrace more than the development and diseases of the sexual organs. In the child, and up to the advent of puberty these diseases are few, and may be regarded as

accidental. The developmental faults even rarely acquire importance until the advent of puberty. Then if the organs are faulty, and their relations to surrounding organs are abnormal, the performance of their functions may be so hindered that distress may ensue in the organs themselves, in their immediate surroundings, or in distant organs; or disorders of hæmatosis, nutrition, or other general processes may be induced. In the old woman the sexual organs, having fulfilled their functions, undergo what may be called senile atrophy. The ovaries, the uterus, the vagina often, and the breasts shrink: they are no longer the centres of active nervous and blood distribution; they become inert, and henceforth exercise but feeble influence upon the general organism. Unhappily this normal course is not always observed. Towards the climacteric there is too often developed a tendency to certain morbid processes in the ovaries, uterus, vagina, and breasts, which compel the attention of the gynæcologist. Instead of undergoing what may be described as the normal process of quiet extinction, their tissues exhibit aberrant forms of nutrition and degeneration, as fibroma or cancer, and then again the pelvic organs become active foci of blood-distribution and growth, entailing local distress, and general, it may be life-imperilling, disorder. And even when no morbid tissue-change occurs, when the organs yield to the process of extinction, various phenomena commonly show themselves, always more or less distressing; and which often assume pathological import. The sexual apparatus no longer dominating the system, the balance of healthy action and reaction being lost, the nervous force not finding its long-accustomed use, wanders off in strange paths, and in its erratic play reveals various nervous phenomena, not seldom mistaken for special neuroses—as neuralgia, hysteria, syncopal attacks, or vertigo, or even convulsive attacks simulating or even merging into epilepsy, hemianæsthesia, or hemiplegia, single or combined, and mimicking apoplexy or paralysis; and various mental aberrations more or less rebellious to the will, a very common phenomenon being enfeebled memory and unsteady volition. Associated or not with some of the foregoing phenomena are various subjective phenomena of sensation. Illusive pregnancy—the *pseudocyesis* of Mason Good—is one of the most familiar. Certain peripheral sensations, as tingling, pricking, numbness of the limbs, chills and flushings, sometimes profuse perspirations, itching—when occurring in the pudenda assuming the character of pruritus—this in many cases associated with, and apparently dependent upon, irritating discharges from the uterus and vagina, the expression often of organic disease, in other cases with glycosuria, but in all probably with some perturbation of the glandular system. Here we see proof of the intimate connection of innervation, nutrition, and glandular action. This origin of glycosuria is but one example of the influence of perverted or diverted nerve-force, in altering the constitution of the blood, and disturbing the work of the glandular organs. To trace these and their allied physiologico-pathological processes with any approach to completeness—and the theme is tempting—would lead us far beyond the narrow scope necessarily assigned to this article. Here we can only afford to give them a passing glance. One remark to emphasize the lesson the philosophical contemplation of them conveys is, that these phenomena taken together are integral parts of the play of the female economy, linking the climacteric and senile epochs of woman with that of her sexual vigour; that, occurring as they do in subjects of known sound organisation, at a definite time and under conditions exceptionally easy to trace, they throw an independent and strong light upon the genesis and nature of like disorders in the male, thus showing how what is called special pathology may help to solve many of the problems of general pathology. If we were to extend this reasoning so as to embrace illustrations from the processes of pregnancy and childbed, the argument would be greatly strengthened. We should see the strongest evidence that since such affections as glycosuria and albuminuria may begin in subjects whose liver and kidneys are sound, and disappear leaving them sound, we may certainly infer in many cases, and so presumably in more if not in all, that these and other aberrant processes do not depend for their origin upon change in the organic tissue of the organs which appear to be their immediate and necessary seats. These affections may be defined as evidences of disturbance in the work of the system. To regard them as disease is arbitrary and unphilosophical. It may then be safely affirmed that the study of gynæcology, pursued in a liberal spirit, bears the most instructive testimony to the law which declares that there is no proper boundary between physiology and pathology; that pathology is but a chapter in the history of physiology; a proposition which may be otherwise expressed by the aphorism: *Pathology is simply physiology in difficulty.*

We must bear in mind that all the great pathological processes may assail the ovaries, uterus, or breasts; that all the diatheses may stamp their work upon these organs. And this they may do apparently primarily or with especial activity; or secondarily, in the course of the development of the morbid process in other organs, or in the system at large. Thus we are familiar with cases of cancer starting to all appearance in the uterus; the disease from this centre or focus invading the surrounding structures, and empoisoning the blood. To form a just appreciation of these cases, it is obvious that a clear knowledge of the general history of cancer, as well as of its special local history, is necessary. A similar proposition may be affirmed with regard to struma, although the general and local relations may be more obscure. But the gynæcologist is familiar with the clinical fact that in a considerable proportion of cases of endometritis, of hyperplasia, and subinvolution of the uterus, and of perimetric inflammations and effusions, cure is extremely difficult—difficult beyond what his experience of simple uncomplicated cases of nominally the same kind would lead him to expect. He may safely assume that in a large proportion of these cases there is an underlying diathesis, frequently the strumous, which stamps its mark upon the tissues, modifying the progress of the morbid action, and challenging general

as well as local therapeutical aid. In this connection an incidental observation may be made. Some of the most obstinate cases of endometritis and hyperplasia the writer has met with were in women who had resided in the East, and whose constitutions had been damaged by endemic disease. These women had in fact acquired a diathesis deeply affecting the nutrition and the tissue-constitution of the body, which revealed its influence most conspicuously in the uterus, an organ whose integrity had been severely tested by pregnancy and the other conditions of married life.

Another law is of deep import, from a scientific as well as from a clinical point of view. Almost all the constituent elements of the body are represented in the uterus, modified of course in arrangement, and assuming certain peculiar characters in order to subserve the particular functions of the organ. But the modifications so acquired do not deprive these fundamental elements of their original and essential properties. By these fundamental properties these elements are attached indissolubly to general pathology; by these specially adapted modifications these elements become the seat of our so-called special pathology. Thus the fibro-muscular tissue of the uterus is liable to all those departures from the healthy type, as fibroma, myoma, fibro-myoma, hyperplasia, hypertrophy, and the degenerations, to which like tissues elsewhere are liable. They may indeed assume special importance because, occurring in the uterus, they almost necessarily disorder the proper functions of the organ. They belong to the domain of general pathology nevertheless. But in this special disturbance of function we find the special aspect of the tissue-change. The retention of the essential properties of the component tissues of the body is strikingly manifested in the vascular, lymphatic, mucous, and connective tissues of the uterus. They are not only subject to the like physiological and pathological changes which the same tissues elsewhere are subject to; they link the pelvic organs to the general system partly by continuity of tissue, as especially in the case of the vascular, lymphatic, and connective tissues; but they carry morbific elements from the uterus into the general system by absorption. They thus are '*poison-routes*'—channels by which poison or noxious matter, forming in, or inoculated in, them, enters the blood, and thus empoisons the entire organism. It will not escape attention that the mucous membrane of the vagina and uterus is in pre-eminent degree exposed to contamination from external sources. It is needless to do more than refer to the direct infection from the gonorrhœal and syphilitic poisons. The gonorrhœal poison implanted on the mucous membrane of the vagina or cervix uteri sets up *in loco* its specific inflammation, and may spread along the mucous tract through the cavity of the uterus, and the Fallopian tubes; and the empoisoned secretion escaping into the abdominal cavity, may set up a severe form of pelvic or even general peritonitis. The syphilitic poison in like manner, first attacking the mucous membrane, may from this point of departure invade the general sytem. Then there are the more subtle instances of local and general syphilisation, through an ovum impregnated by the tainted male. The connective tissue again is of far more than merely local importance. Like the same tissue elsewhere, it is a most active poison-route, mainly no doubt through its relations with the lymphatic system.

There is a therapeutical corollary from this law, that deserves earnest practical attention. A great part of the treatment of uterine diseases in which there is change of tissue, as hyperplasia of the mucous membrane and muscular wall, is surgical, that is, it consists in the topical application of caustics, absorbifacients, or antiseptics, as iodine, carbolic acid, bromine, and so forth. These no doubt act in the first place directly *in loco* upon the tissues touched, modifying their state. But what is not so well known, and is rarely if ever designed or contemplated, is that some remedies so applied—notably iodine—are absorbed, and thus may affect the system. Under some conditions, as where the mucous surface is large, or when the epithelium-investment is lost, or where the quantity of the agent is large, and more especially when the absorbing function is in a state of peculiar activity, the general intoxication may be excessive, even dangerous. The writer has seen the most intense iodism produced in this way, and cases are recorded of poisoning by chromic acid. But if this law, and the conditions under which it acts, are borne in mind, remedies can generally be so applied as to draw from them both local and constitutional benefits in the happiest manner.

There are two modes in which iodine, for example, may invade the system: first by imbibition or endosmosis, the tissues becoming permeated or soaked by the fluid; secondly, by absorption into the lymphatics and veins. There is a local iodism, and a general iodism. By analysis we may resolve the complex action at work into the following factors; first, there is the direct mechanical or chemical action of the iodine upon the surface touched by it; secondly, there is the action upon the submucous and muscular tissues of the uterus, the effect of their permeation; thirdly, there is the constitutional action upon distant organs, upon general tissue-nutrition, in which the tissues of the uterus share, the remedy being brought round again to it by the circulation; and fourthly, there is an action little thought of, from which the most useful effects have been often unconsciously drawn—namely, the antidotal action of the remedy topically applied upon certain septic matters originating in the uterus, and thence invading the system. The same channel that gave entrance to the poison is made to serve as a channel for the antidote. Thus the poison-route is in turn made a remedy-route, the antidote closely chasing the poison. The application of this principle is seen most strikingly in the treatment of syphilis and cancer, but it may be turned to useful account in the treatment of other morbid conditions.

Pregnancy and child-bed constitute the most indisputable part of the territory assigned to the gynæcologist. In the careful study of the parturient process, we shall discover the secret of many of the disorders of menstruation, and arrive at a clearer understanding of the relations,

physiological and pathological, of the sexual organs to the general system, than could otherwise be attained. This is to say, that the study of obstetrics is inseparable from the proper study of the diseases of women. Parturition is the culminating point in the functional work of the ovaries and uterus. All the other points in this work are subservient to parturition. It is true that in many cases this ultimate aim is not reached. But it is not the less true that this is the aim which Nature is always striving at. She may fail at any stage of the journey. Every menstrual nisus is truly a mimic or missed pregnancy. The points of analogy, or homology, are striking. Descending from the observation of parturition at term to the observation of premature delivery and abortion, we shall find strictly related and similar phenomena in ordinary menstruation; and then passing from the ordinary or healthy type of parturition to the so-called abnormal types, again we shall find reproduced homologous processes in the various forms of paramenia, especially in dysmenorrhœa. And this is so true that the most effective principles of treatment flow from this comparative study. Many cases of nervous disorder, as vomiting, convulsion, neuralgia, such as we see in the most definite relation to pregnancy and childbed, have their exact counterparts in some forms of dysmenorrhœa; various blood-diseases, as anæmia, septicæmia, thrombosis, embolism, which we have so many sad opportunities of observing in childbed, are produced in the non-pregnant state from disturbed menstruation, or uterine disease, notably from cancer; blood-poisonings associated with glandular disorder or disease, as glycosuria, albuminuria, jaundice, simple and malignant, of which the most striking types occur in pregnancy and childbed, find their representation in the non-pregnant state.

Making liberal allowance for the proverbial difficulty of framing definitions that shall be proof against criticism, and against the infinite complications of natural history, we may cite the following as presenting a minimum view of the work of the gynæcologist. It embraces the study and treatment of the disorders and diseases of the female generative organs and their immediate surroundings—including pregnancy and parturition, and the disorders and lesions, general and local, which result from these processes.

We may set out some of these heads more particularly, as follows:—

*Scheme of the Diseases of Women.*

1. In infancy and childhood. Faults of development of the sexual organs; and the accidents from injury or disease to which they are liable.

2. At puberty and during the virginal state. Some of these are consequences of the developmental faults of the first order; others arise from functional difficulties, from diatheses, &c.

3. The normal and abnormal history of pregnancy and parturition.

4. The injuries and diseases consequent on parturition and childbed.

5. Mechanical or strictly surgical affections of the ovaries, uterus, and vagina, original or acquired. These include displacements or malformations of the uterus, and diseases of the ovary and broad ligaments.

6. The disorders of senility, subdivided into two classes:—(*a*) Those of the climacteric, more immediately attending and following the menopause. (*b*) Those of senility proper.

7. Those general diseases which are strictly associated with error of function of the ovaries and uterus; and those cases of general disease, of which the chief action is expended upon these organs. The former will include cases of chloro-anæmia, &c.; and the latter cases of struma, syphilis, cancer, &c., affecting the ovaries, uterus, and vagina.

8. The diseases of the breast, as mastitis, and the conditions immediately connected with pregnancy, childhood, and lactation. Most of the other diseases of this organ have fallen by a natural process of selection to the surgeon.

The special diseases of women will be found fully discussed in other parts of this work, under their respective headings.

ROBERT BARNES.

**WOODHALL, in Lincolnshire.**—Common salt waters, containing iodine and bromine. *See* MINERAL WATERS.

**WOOLSORTERS' DISEASE.**—A form of anthracoid disease. *See* PUSTULE, MALIGNANT.

**WORMS.**—This is a popular term, which in medical practice is applied in a restricted sense, as embracing only certain forms of entozoa or internal parasites that reside in the intestines. The word, as thus employed, originated from an entire misconception in regard to the supposed affinities subsisting between the round-worms or lumbricoids and common earth-worms. Structurally these kinds of creatures, though both vermiform, are essentially distinct. In a wider and purely technical sense, however, many distinguished zoologists (Gegenbauer, Rolleston, &c.) retain the term as an expression of high group value, embracing all sorts of annulose animals, parasitic and free. By some practitioners the employment of the term 'worms' merely signifies that a patient is suffering from ascarides or thread-worms. *See* ENTOZOA; HELMINTHES; and VERMES.

T. S. COBBOLD.

**WRIST-DROP.**—A form of paralysis, chiefly affecting the extensors and supinators of the wrist, and due almost exclusively to chronic lead-poisoning. *See* LEAD, Poisoning by.

**WRITER'S CRAMP.**—SYNON.: Scrivener's Palsy; Fr. *Crampe des Écrivains*; Ger. *Schreibekrampf*.

This disease may be taken as the most common form and most typical representative of a class of diseases which Duchenne has called 'functional impotences.' In them we find the patient complaining of inability to execute some complicated act, the power to perform which had taken him perhaps years (in the case of writing) to acquire. As a rule there is no other trouble, and, as far as the patient's observation goes, all muscular acts, however delicate or however complicated, are accomplished without difficulty, with the exception of one, which unfortunately is usually that with which

the patient earns his living. Not only have cases of 'writer's cramp' been described, but English and foreign physicians have furnished accounts of 'piano-player's cramp' in which an inability to strike chords with correctness is present; of violinists who have lost the power of holding the violin, and fingering with the left hand; of violoncello-players who have become powerless to 'make the nut' with the phalangeal joint of the left thumb; of tailors who can no longer use the needle; of dairymen who fail in milking; of bricklayers who cannot wield the trowel; of smiths who cannot use the hammer; of compositors who cannot place the type; and lately we have had accounts of telegraphists who have become unable any longer to work at their calling. 'Writer's cramp,' however, is by far the most common of these diseases, and while the others which we have mentioned must be regarded as the rarest of medical curiosities, the one which we have chosen to illustrate the class is tolerably often met with.

Symptoms and Course.—The symptoms and course in a typical case of writer's cramp are as follows:—A clerk, who from his painstaking and energetic habits has been tempted by his employers to work over-time or possibly against time, and who perhaps (as the history of these cases often shows) is harassed by domestic troubles, discovers that he does not write quite as easily as he did, that his hand possibly aches after prolonged writing, and he finds it convenient to adopt some new method of holding his pen. At first the trouble is hardly noticeable, and then he finds himself obliged to grasp his pen with unusual tightness to prevent its becoming unsteady. Then his handwriting begins to suffer: perhaps his forefinger refuses to remain steadily upon the penholder, and while he is making every effort to control it, the pen somehow or other eludes his grasp and falls from his hand. If he persevere—probably he is one of those who would sooner die than give in—his progress downhill is rapid and certain. Every possible method of holding the pen is adopted by turns, such as interlacing it between the fingers, grasping it firmly with the whole hand, using only the first and second fingers without the thumb, or the thumb and second finger without the first, but these subterfuges quickly fail to be of service. He cannot steady the pen by means of them, and he finds that the arm rolls possibly inwards or outwards, and that he can only form his letters by moving the whole arm from the shoulder, or lastly by fixing the arm to the side and swaying the whole body to and fro. The handwriting soon becomes illegible; and lastly the patient is almost unable, even by the most strenuous efforts, to make a mark upon paper. To write a word legibly in extreme cases is impossible, and there are few spectacles more distressing than to see a patient, whose handwriting was perhaps his means of livelihood, drip with perspiration while making an ineffectual effort to sign his name. His loss of writing power may be his only symptom, as was the case with an American sufferer who wrote thus to the writer: 'that fingers which could guide razor and needle, wield oar and musket, and, though numb with cold, knot and cast off reef-points on a wet sail, should yet strike work when called on for the familiar characters of their owner's name, seemed utterly beyond comprehension.' Patients should be closely questioned as to their ability to perform acts other than writing. In the writer's experience it is usual to find that some other act or acts is affected. If the patient be asked if he can wind up his watch, carry a full tea-spoon steadily to his mouth, or perform some similar act requiring a *delicate* use of the thumb and forefinger, it will very commonly be found that he has lost his deftness in performing such acts, although in using a knife or wielding a hammer, and in performing functions requiring a coarse use of muscles other than those used in writing, he may find no difficulty whatever. Frequently there are neuralgic pains, or a sense of extreme fatigue in the hand and arm; and in some cases the effort to write has been followed by pain in the back, or severe headache. In some cases the mental distress caused by the loss of power has produced a condition bordering on melancholia. Slight tremor of the hand is not uncommon, and these tremors sometimes occur independently of writing. Tenderness of the nerve-trunks (median, ulnar, or musculo-spiral) is very often present, and should always be carefully looked for, as indicative of congestion of the nerves, or neuritis. Occasionally there is objective spasm of some of the muscles of the arm when the effort to write is made; and one case has been reported by the writer, in which the symptoms at first were those of simple loss of writing power, but which terminated in a general clonic spasm of all the muscles of the arm, apparently at last independently of any writing effort.

Although the above is a typical case of 'writer's cramp,' other cases are by no means uncommon, in which impairment of writing power supervenes quite independently of any unusual writing effort, and even in persons who have done rather less than an average amount of writing. These latter cases are not usually so severe as the former, since they are not obliged, as is the professional scrivener, to goad the unwilling hand to make those efforts which are so detrimental. It has been the writer's experience too, that in this latter class of cases it is more usual than in the former to find that the trouble is not very strictly limited to the act of writing, but that there is a certain amount of inability or clumsiness in the performance of other acts requiring minuteness and nicety.

Pathology.—The morbid anatomy of writer's cramp is unknown, and consequently the pathology of the disease is a matter of speculation. Mr. Solly, from the fact that 'pain in the back was a not unfrequent concomitant symptom,' was of opinion that degenerative changes probably occurred in the spinal cord, which is possibly not unfrequently the case, the failure of writing power being merely the prelude to more severe and more general symptoms. Dr. Reynolds says: 'It cannot be doubted that some changes take place in the nutrition of the parts through which the lines of nerve-action regulating the secondarily automatic movements run. It seems probable that the association of movements is effected by ganglia which are common to fibres passing through distinct but

contiguous nerve-trunks, and that it is owing to some nutritive change in them, the result of persevering and forced effort, that the perfection of movement is produced; associations at first caused by the will are at length produced unconsciously. What happens, then, in such maladies as writers' cramp is a perverted nutrition of these parts.' Duchenne believes that the change is in the nerve-centres first, because localised faradisation applied to the hands has no good effect on the trouble; and he is confirmed in this opinion because the malady very quickly affects the left hand if it be used to supply the place of the right. The writer has ventured to suggest that the lesion is, in typical cases at least, situated at the periphery, either in the muscles themselves, or in the terminal motor nerves supplying these muscles. In real cases of writer's cramp (the loss of writing power occurring in an overworked scrivener) it is rare to find any sign of central change; neither wasting or true paralysis of muscle, nor fibrillary tremor, nor general tremor of the limb, nor pain, nor spasm (except during, or immediately after, the attempt to write). It is generally observed that the disease progresses from the periphery towards the centre; that the muscles of the fingers are the first to fail, then those of the forearm, then those of the arm, and lastly, in extreme cases, those of the trunk. It is probable that the muscles of pen-prehension, as opposed to those of pen-movement (consisting of the adductor pollicis, first dorsal interosseous, &c.) drift into a condition of 'chronic fatigue' owing to the *prolonged strain* to which they are subjected when holding a pen for long periods at a time. When these normal muscles of pen-prehension are exhausted, others are used to supply their place, such as the superficial and deep flexors in the forearm, &c., which in their turn give out, and thus the trouble steadily progresses. The writer has had no small experience of this disease, and he has never failed to find that a careful electrical investigation of the muscles has shown a certain diminished irritability to faradisation in the muscles of pen-prehension on the diseased side, when compared with those of the sound side. This loss of irritability is due, in many cases, he believes, to sheer over-use of the muscles, the intervals of relaxation between the long periods of contraction not being sufficient to allow of their proper nutrition. In many cases of 'writer's cramp' no over-use of the muscles has taken place, and in such cases we must suppose that, from some condition, either constitutional or situated locally in the nerves, the muscles are so deficient in 'staying power' (notwithstanding their ability to contract forcibly for a short time) that they become useless, or nearly so, when called on for prolonged steady contraction. It is obvious that the failure of one muscle (however small) which had been taught, by years of laborious education, to act in harmony with many others for the accomplishing of a complicated and delicate act, such as writing, would produce a true want of co-ordination. In other words muscles which have been induced *to work in order together* no longer do so if one of them fails, and the failure of one must be fatal to the accomplishment of the co-ordinated act.

Diagnosis.—Diagnosis is of great importance, since failure of writing power is often an early symptom of disease the prognosis of which is very different from that of 'writer's cramp.' Evidence of chronic alcoholism is often afforded by the handwriting. So again paralysis agitans and disseminated sclerosis of the spinal cord may very early give a want of steadiness to the pen. Dr. Reynolds records a case of lead-palsy, which was sent to him as a case of writer's cramp. Paralysis of any of the nerves supplying the hand or forearm, such as the ulnar, median, or musculo-spiral, will make writing difficult; and the writer has seen cases of progressive muscular atrophy, in which the shrunken and quivering interossei had made a firm grasp of the pen impossible.

Treatment.—The chief remedy is rest. Without it nothing can be done, and if rest be taken in the earliest stages of the disease, complete recovery not unfrequently results. For such writing as is absolutely necessary, the patient should be advised to use a pencil or soft quill pen, so that any violent grasp becomes impossible. In many cases the writer has found the rhythmical exercise of those muscles whose irritability is impaired, together with the employment of a mild galvanic current, of the greatest service, and he has recorded a few cases treated in this way which rapidly improved, after having resisted every other known method of treatment for years. Injection of morphia is of no use, but in America some good has been said to result from the injection of atropine. If any of the nerve-trunks be tender, these should be blistered.

G. V. Poore.

**WRY-NECK.** — Synon.: Torticollis; Fr. *Torticolis*; Ger. *Steifer Hals.*

Definition.—A twisting of the neck to one side.

Ætiology.—Wry-neck is a symptom which may be produced by very different conditions; and it is usual to distinguish between the varieties of this disease, which may either be *congenital* or *acquired.*

The *congenital wry-neck* arises either from faulty development of the muscles on one side of the neck (in which case there are not unfrequently evidences of faulty development in other regions of the body, and notably in the neighbouring parts, such as the face); or from paralysis of the muscles on one side, often due to accidental injury during labour. In these cases the head is fixed in its abnormal position. *Acquired wry-neck* may be a mere passing condition, due to 'muscular rheumatism,' brought on by exposure to cold, and under the name of 'stiff-neck' it is familiar to everybody (*see* Rheumatism, Muscular). The most formidable variety is *spasmodic wry-neck*, which makes its appearance, usually in persons otherwise healthy, about the middle period of life. The muscles on one side of the neck are the seat of spasm, sometimes tonic, but usually clonic in character. The muscle chiefly affected is generally the sterno-cleido-mastoid, and its constantly recurring contractions have the effect of turning the head away from the side which is the seat of spasm; drawing the occiput slightly

downwards, and the chin slightly upwards. Other muscles, such as the scaleni, splenius, and trapezius, are not unfrequently affected also, and then, in addition to the rotatory twisting of the neck, we get a lateral downward bending, and an elevation of the shoulder. At the commencement of the disease the trouble may be slight, and cause but a trifling amount of inconvenience, the impressions produced on a bystander being that the patient's movements are caused by some mal-arrangement of the dress, which he is seeking to remedy. In its advanced form the disease is a very terrible one, and may make life hardly supportable. The writer has seen one case in which the spasm was so violent, that the constant forcible impinging of the chin upon the shoulder of the sound side had produced a sore place as big as a shilling. The spasm ceases during sleep; and when the patient is undisturbed, and his mind pre-occupied, it is not unusual, even in the worst cases, for considerable remissions of the symptoms to occur. In the presence of others, especially strangers, the spasm is usually intensified, and in this it presents a striking similarity to stammering and writer's cramp.

Pathology.—The pathology of spasmodic torticollis is very doubtful. It must be regarded in almost all cases as a true neurosis, and must take its stand alongside of histrionic spasm of the face, writer's cramp, and stammering. That it is due in many cases to an irritable condition of the spinal accessory nerve there can be no doubt, but how this condition of nerve is brought about we are unable to say. Want of proper antagonisation is another factor which is always present, for without it the symptoms could not occur. In certain nervous constitutions a weakened action of one sterno-mastoid would seem of itself to be almost sufficient to excite irregular contractions in its fellow. The writer has seen one case in which it seemed tolerably clear that the sterno-mastoid and trapezius on one side had become weakened by overwork, and had drifted into a condition of chronic fatigue, while their antagonists were constantly in a state of clonic spasm, twisting the neck to the weakened side. An electrical examination of the muscles generally shows that, while those which are the seat of spasm have their irritability greatly increased, their antagonists are below their normal state as to irritability. Torticollis is usually, but not always, uncomplicated. That condition known as 'irritable spine' has been observed in some few female patients; histrionic spasm, or spasm of the limbs, has occurred as a complication, and it is not a little remarkable, as showing connection between the two diseases, that Dr. Reynolds has recorded three cases of torticollis in which the patient had suffered previously from writer's cramp. A difficulty of deglutition was observed in one of Dr. Reynolds's cases; and in another there was swelling of the arm, from pressure upon the subclavian vein.

Prognosis.—The prognosis of these cases is bad, it being very unusual for recovery to take place after the disease has become well established.

Diagnosis.—The diagnosis of wry-neck, as a rule, is not difficult, but care must be taken that simple torticollis is not confounded with cases of caries of the cervical spine, in which there is frequently a tendency for the head to twist to one side. It should be borne in mind, also, that in some few cases of organic brain-disease, in which synergic movements of the eyeballs have occurred, a spasmodic rhythmic movement of the neck has also been observed. The other symptoms of brain-disease, however, would usually prevent any such mistake.

Treatment.—This necessarily depends upon the cause of wry-neck. In those cases in which the head is fixed by contraction or faulty development of the muscles, tenotomy has been of service, and although it has been practised also in those cases in which there has been definite clonic spasm, and notwithstanding that temporary relief has in some cases followed, it is found that the deep-lying muscles are almost certain to take on a spasmodic action, and that in the end the patient's discomfort is increased rather than diminished. Various mechanical contrivances for steadying the head have been devised, but few patients are able to bear the constant pressure of the apparatus, and the remedy has been found in most cases worse than the disease. Some good has resulted from the long-continued use of hypodermic injections of morphia, and Dr. John Harley has recently reported some cases which have been greatly benefited by the exhibition of large doses (℥j. and over) of the succus conii. Electricity has not been particularly serviceable in the treatment of torticollis. The galvanic current has been used to control the spasm, while the weakened antagonising muscles have been stimulated by faradisation, and although improvement has been produced by these means, it has generally been of very short duration. The writer has lately had a very severe case under his charge, which was successfully treated by the employment of the continuous galvanic current, combined with the rhythmical exercise of the affected muscles. The positive pole being placed behind the ear, the negative pole was applied over the sterno-mastoid and trapezius, and at the same time the patient was made to exercise these muscles by shrugging the shoulder, twisting the head, &c. The result was very rapid and permanent improvement. Another case has also been no less successfully treated by the writer by faradising the antagonist muscles, which were somewhat wasted and decidedly deficient in irritability. This patient completely recovered; although tenotomy of the sternomastoid, which was the seat of spasm, had afforded only temporary relief.

G. V. Poore.

# X

**XANTHELASMA** (ξανθός, yellow, and ἔλασμα, a lamina).—A yellow growth in the superficial layer of the skin, assuming the form of a lamina or plate, and more frequently met with in the eyelids than elsewhere. *See* XANTHOMA.

**XANTHOMA** (ξανθός, yellow).—SYNON.: *Xanthelasma.*

DEFINITION. — A peculiar kind of yellow growth, originally observed in the integument, but subsequently in the areolo-fibrous tissues elsewhere.

ÆTIOLOGY.—Xanthoma must be referred to a defect of vital power, affecting the nutrition and growth of certain of the tissues of the body—in the present instance the connective tissue, and especially that of the surface membranes of the body. A similar cause will serve to explain the concentration of pigment which is observable in the integument of the eyelids in these cases. It is deemed probable that this affection may be related to a morbid function, if not to a morbid organic condition of the liver. The latter organ has frequently been found diseased in association with these cases, and in one instance every organ of the body would seem to have been in a state of disease. On the other hand, xanthoma has been seen in persons apparently sound in every other respect; therefore it would seem that there is nothing to prevent it from affecting the sound as well as the diseased. Some curious cases have lately been recorded of xanthoma in children in whom the disease had been present from birth or early infancy. Instances of heredity of the disease have been noted.

ANATOMICAL CHARACTERS. — Pathologically, xanthoma is a new growth of harmless character, a form of degeneration taking place in the superficial integuments—cutaneous, mucous, and serous, and in some instances in the subjacent areolo-fibrous tissue. The morbid structure is composed of an areolar network of connective tissue, enclosing areolæ filled with cell-germs, and traversed by a scanty plexus of minute blood-vessels. The process is accompanied by fatty degeneration of the young cells, and the formation of cholesterine crystals. The papulæ are not due to a collection of sebum within the follicles, as Hebra suggested; neither is the colour dependent on the absence of pigment in the rete mucosum, as in vitiligo.

DESCRIPTION.—Xanthoma presents itself under two forms: first, as isolated nodules, *X. tuberosum*; and, secondly, as smooth plates or laminæ of moderate dimensions, *X. planum*. It is to this latter form that the term 'xanthelasma' was intended to apply; and in consequence of the greater frequency of the disease in the eyelids than elsewhere, the term *X. palpebrarum* was invented to distinguish such cases from those in which it occurs in both its forms, and on other parts besides the eyelids, and to which the term *X. multiplex* has been applied.

On the eyelids xanthoma may be recognised as a yellow spot, slightly elevated, with a rounded outline, oblong and generally solitary, but sometimes accompanied with several papulæ of similar colour scattered around the circumference. It occurs most commonly near the inner angle of the upper eyelids, and is usually symmetrical on both eyes. Next it is met with at the inner extremity of the lower eyelids, and in extreme cases surrounds the opening of the eyelids more or less completely. Its colour varies from that of cream or a pale primrose to a deep orange-yellow. On careful examination with a lens, the patch may sometimes be seen to be granulated (*X. granulosum*) on the surface, many of the granules or nodules being punctated by the aperture of a follicle; and in the isolated papules this structure is even more distinct. There is some slight variety in the degree of prominence; usually there is no redness or indication of hyperæmia, and the surrounding integument has a dusky or brownish tint of various degrees of depth. There is no pain of a spontaneous character, but instances are no record where nodules about the hands have been so tender as to prevent the patient handling anything.

Independently of its presence on the eyelids, with which it was formerly specially identified, the disease has likewise been seen, in order of frequency, on the palms and soles, knuckles, ears, flexures of joints, nose, and cheeks; in advanced cases on the back and abdomen, as well as the face and limbs. It frequently attacks the mucous membrane, and has been seen on the lips, tongue, and palate; also on the trachæa and bile-ducts; in the subcutaneous areolo-fibrous tissue; and in the subperitoneal tissue of the abdomen and of certain of the abdominal viscera.

DIAGNOSIS.—The diagnosis of xanthoma is determined by its colour, its situation, its material structure, and its predominant forms—always circumscribed, sometimes occurring as rounded papules or tubercles, sometimes as laminæ, smooth on the surface or granulated and nodulated.

PROGNOSIS.—Xanthoma is essentially chronic in its nature, but otherwise harmless, uninfluenced by constitutional treatment, but removable by surgical operation when limited in extent. It rarely gives rise to inconvenience, and is chiefly objectionable from its appearance. A noted instance of the spontaneous disappearance of xanthoma nodules has been recorded by Wickham Legge.

TREATMENT.—Assuming that no local disease can occur without some constitutional derangement, and having our attention drawn to a probable defect of function of the liver and possibly of the digestive organs, it is not unreasonable to direct our treatment to the regulation of those functions. Nitro-hydrochloric acid with a bitter, and the occasional use of blue pill, are both indicated. Subsequent to these

remedies we may have recourse to arsenic, as a nutritive tonic possessing special properties of peripheral action. Locally, destruction of the morbid tissue by means of caustics naturally occurs to the mind; and where the extent of the disease is limited, it may be effectually removed by potassa fusa. The case is hardly grave enough for the use of the knife, although it is sometimes resorted to; and excision would probably be attended by the after-inconvenience of contraction of the integument.

ERASMUS WILSON.

**XERODERMA** (ξηρὸς, dry, and δέρμα, the skin).—DESCRIPTION.—Xeroderma is a state of defective nutrition or atrophy of the integument, distinguished by dryness, roughness, and greyish discolouration. The skin is poor and starved, hard and wrinkled; the epidermis is thickened, sometimes desquamating, and sometimes accumulated in crust-like masses, corresponding in figure with the area of motion of the integument. The disease is unaccompanied by any subjective sensation. The perspiratory function is impaired. Xeroderma is congenital and sometimes hereditary, and may vary considerably in degree, entitling itself in its more severe forms to be considered as ichthyosis, the latter disease being always accompanied by xeroderma. The term has also been applied by German writers to a rare form of atrophy of the skin, with disturbance of pigment and nævoid changes. *See* ICHTHYOSIS.

ERASMUS WILSON.

# Y

**YAWNING** (A.-S. *gânian*).—SYNON.: Fr. *Bâillement*; Ger. *Gähnen*.—Yawning is one of the physiological expressions of fatigue. It consists, when fully developed, of the following phenomena:—1. A deep inspiration, with elevation of the uvula and palate. 2. A forcible spasmodic depression of the lower jaw. 3. A flow of tears. 4. A clicking sound in both ears. 5. A tendency (sometimes irresistible) to stretch the limbs, especially the arms. 6. An expiration, often accompanied by a sound, the character of which has probably given the name to the act.

ÆTIOLOGY AND PATHOLOGY.—This strange and complicated act suggests many reflections. Why, when we are tired, should we take a deep breath? It may be that the need of oxygen experienced by the fatigued tissues, laden with waste products, prompts the instinctive and forcible descent of the diaphragm; but, on the other hand, the facts that yawning is common when we are merely *ennuyé* and not genuinely fatigued, and that it is decidedly infectious, are both unaccountable on such a theory. Why should the lower jaw be spasmodically depressed when we are fatigued? The elevators of the lower jaw are the temporal, masseter, and internal pterygoid muscles, and it is probable that the external pterygoid (whose main functions it is to move the jaw forward) has also some share in keeping the teeth in contact. These muscles are constantly in action, having to support the jaw against the force of gravity; and it is not surprising that, as in other cases of prolonged muscular action, they should be prone to evince fatigue by failure of function. Were it not for the fact that this work of supporting the jaw is divided amongst eight muscles (four on either side), it is probable that the jaw would fall more often than it does. When one set of muscles is fatigued, it is quite in accordance with experience that their antagonists should take on a spasmodic action, and we may fairly look upon the spasm of the depressors of the jaw, when the elevators are fatigued, as the physiological expression of an occasional pathological phenomenon. These considerations again do not apply to those instances of infectious (emotional) yawning in which we are impelled to imitate what we see in others.

A fact of considerable interest in connection with yawning is the great extent to which its phenomena are limited to the area of the fifth nerve. The four muscles mentioned above, as concerned in the negative phase of yawning, are all supplied by the fifth; and the anterior belly of the digastric and the mylo-hyoid muscles, which are connected with its positive phase, are also supplied by the fifth. The flow of tears and the 'click' in the ears, which is probably due to a contraction of the tensor tympani, are also referable to the influence of the same nerve. The tensor palati is likewise in action; so that we may say that every muscle supplied by the fifth is concerned in yawning. Possibly yawning may be regarded as a reflex phenomenon, of which the most ordinary stimulus is the fatigued condition of the elevators of the lower jaw. The reflex effects are largely manifested in the area of the fifth nerve, but they clearly spread beyond it, and produce contraction of the diaphragm, palatal muscles, depressors of the hyoid bone and larynx, and sometimes of the muscles of the body generally, but mainly of the extensors. That the contraction of the body muscles at least is a purely reflex phenomenon, may be gathered from the interesting fact which has been often observed in cases of hemiplegia, namely, that when a hemiplegic arm is entirely beyond the control of the will, and its flexor muscles are contracted, this contracted helpless hand will often open during yawning, the stimulus having reached the extensors of the fingers, not through the ordinary path of the will, but through the spinal cord by a reflex action travelling along some other path of nervous energy.

TREATMENT.—Yawning is generally only a passing phenomenon, which is removed by rest. An undue tendency to yawn may indicate that the body is too easily fatigued; and then it may

be necessary to inquire whether the demands upon it (mental, physical, or sexual) are too great. These may have to be removed or avoided. At the same time the bodily health should be carefully attended to. Iron tonics may be given; the foul atmosphere of crowded assemblies should be forbidden; the diet should be nutritious and digestible; and the amount of alcohol should be carefully restricted to that physiological minimum which may be necessary to aid digestion.

G. V. Poore.

YAWS. *See* Frambæsia.

YELLOW FEVER.—Synon.: Fr. *Fièvre jaune*: Ger. *Gelbes Fieber*.

Definition.—A pestilential contagious fever of a continuous and special type; originally developed in tropical and insular America; occurring only in regions between 45° N. and 35° S. lat.; and dependent for its origin and spread upon a temperature not lower than 70° Fahr. Yellow fever presents two well-defined stages. The first extends from 36 to 150 hours, according to the severity of the disease, and is marked by rapid circulation, and elevated temperature. The second is characterised by depression of the nervous and muscular powers, and of the circulation, with slow and often intermittent pulse; jaundice; suppression of urine, albuminuria, and desquamation of the renal epithelium; diminution of the fibrin of the blood, capillary congestion, passive hæmorrhages from the mucous surfaces, and black vomit; fatty degeneration of the heart and liver; and convulsions, delirium, and coma. The fever is not dependent for its origin or propagation on those causes and conditions which generate malarial paroxysmal fever, from which it differs essentially in symptoms and pathology. As a general rule it occurs but once during life.

History.—The origin of the American plague, or yellow fever, is involved in doubt, in consequence of the prevalence in regions in which it occurs, both amongst natives and foreigners, of severe forms of malarial fever, often attended with jaundice, passive hæmorrhages, and black vomit. In the eleventh century, a disease closely resembling yellow fever, known as the Matlazahuutl, made great ravages amongst the Mexicans, but it was peculiar to the aborigines, never attacking white people, whilst, on the contrary, Mexican Indians seldom suffer from yellow fever. According to authors, the first trace of yellow fever was observed at the end of the fifteenth or beginning of the sixteenth century, at San Domingo and Porto Rico; and Columbus, landing at the former place in 1493, lost the greater number of his men, within a year after their arrival, from a disease described as being 'yellow as saffron or gold.' From 1544 to 1635, when it appeared at Guadeloupe, there is no record of any outbreak, but thenceforward it occurred at irregular intervals. In the seventeenth century it spread along the east coast of America, as far as 8° S. lat. and 42° N. lat., appearing for the first time in the United States at Boston in 1693. In the eighteenth century it appeared on the west coast of South America, and extended even to Europe and Madagascar; the great commercial and military activity of this time doubtless favouring its spread, and increasing the frequency of the epidemics, eighteen being recorded as having occurred in San Domingo within the century. Early in 1700 it reached New York. At the beginning of the present century it reached 47° N. lat. in America, and also prevailed in the Canary Islands, in Leghorn, and in the maritime cities of Spain and Portugal. In 1853, 1867, 1873, and 1878 it spread to a large number of cities, towns, and villages in the interior of the American continent, being transported by railroads and ships. During this century it appears to have relinquished its hold upon the northern cities of the Atlantic coasts, and has been concentrated chiefly along the southern borders of the Atlantic and Gulf coasts. Yellow fever has prevailed almost annually as an endemic at Havana from April to December; and from time immemorial it has been endemic at Vera Cruz.

Geographical Distribution.—At an early day it was established that yellow fever is emphatically the disease of strangers in the warm, moist climates of insular and tropical America. It is endemic in the West Indies, and is rarely, if ever, absent, the seasons of the year having but little influence in eradicating it, though the disease is most fatal from May to August. On the other hand, the history of the settlements along the shores of the Gulf of Mexico and Atlantic Ocean has demonstrated that in the more temperate regions it is a disease of occasional occurrence, and not in the strict sense of the term endemic. Since the disease is dependent in a great measure upon an elevated temperature, its occurrence is limited to tropical and subtropical regions, or to countries having a tropical climate, or a summer of sufficient length and heat. Within these prescribed limits the exciting cause seems to exist, but still the fever has seldom, if ever, shown itself except in maritime regions, elevated but a few feet above the sea. From Brazil to Vera Cruz in one direction, and from Barbadoes to Tampico in another, the exciting causes are in constant, though unequal force, depending on differences of seasons, localities, and constitutions. On the Atlantic coast it has extended as far north as Boston, Massachusetts, and Portland, Maine, while in the Mississippi valley it has three times appeared as high as Memphis, Tennessee, in latitude 35° N. In an eastern direction, but within the same parallels, it has extended to Cadiz, Xeres, Carthagena, Malaga, Alicant, Seville, Barcelona, and other cities on the coast and in the interior of Spain. It has prevailed several times at Gibraltar, once at Rochefort, twice at Lisbon, and once at Leghorn. It prevailed at Monte Video, lat. 34° 54′ S. in 1857 and 1872; in Buenos Ayres in 1858 and 1871; once at Panama and Callao, and at Lima and Cuzco in Peru, in 1854 and 1856. In America it reaches from lat. 36° S. to 45° N. on the Atlantic coast, and to 35° N. in the Mississippi valley. On the Pacific coast it extends from 15° S. to 9° N. Longitudinal limits in the same country, 60° to 97° W. In the eastern hemisphere it occurs within the limits of 42° N. and 8° S. It is said not to appear in the East Indies or China.

*Perpendicular distribution.*—The older statements, that yellow fever never extended beyond the height of 2,500 ft., are shown to be incorrect; for it has prevailed in the elevated table-lands of Caracas, 3,000 ft. above the sea-level, on more than one occasion; and in 1854 and 1856, it committed fearful ravages in Cuzco at an elevation of 11,378 ft., and even in other places in the Andes at 14,000 ft. Great variety, however, exists in this respect, for at Xalapa, in Mexico, in the same parallel with Vera Cruz, 4,330 ft. above the sea, it has never prevailed as an epidemic; and the hills in Jamaica and San Domingo are free from the pestilence which rages in the low lands.

ÆTIOLOGY AND PATHOLOGY.—*Relation to population.*—A certain degree of density of population appears to be essential to the production of yellow fever, which never originates in country districts, but is a disease of crowded cities on the shores of the ocean or large rivers, and of ships. Its origin and spread are favoured by the congregation of persons born in a cold climate; and where developed in strangers who have landed in a port in which it is not prevailing, it appears to be referable to the action of endemic causes upon highly susceptible individuals.

*Relation to temperature.*—However violent the disease may be at any place, yellow fever is arrested from the day on which the earth is frozen, and such localities may then be visited with impunity by strangers. The singular occurrence of the disease at the high elevations in the Andes above mentioned, appears to be due to the fact that, whilst in those regions the night and morning are excessively cold, intense heat prevails in the afternoon.

*Incubation.*—The period of incubation appears to vary in different epidemics, and in different individuals in the same epidemic, and may extend from twenty-four hours to weeks or even months. In this respect yellow fever resembles diseases of malarial origin, and differs from the well-defined contagious maladies. Whilst in some a few hours' exposure to an infected atmosphere is sufficient to determine the disease, others may remain unaffected until the end of, or even through, several epidemics. Cases have been known to occur in the winter, weeks after it is supposed that the disease was entirely checked, the poison being looked upon as lying dormant in the system. Like many other contagious diseases, it may be communicated to the fœtus, and this is supposed to partially explain the immunity enjoyed by the natives of localities in which it is endemic.

*Essential cause.*—The various opinions on this point fall under three heads: 1. That yellow fever is a disease induced essentially and solely by contagion. 2. That it is essentially of endemic origin. 3. That being of endemic origin, it afterwards becomes contagious.

The idea has been extensively entertained that intermittent, remittent, and pernicious paroxysmal malarial fevers, as well as yellow fever, assume more or less, according to circumstances, the type of one another, and are essentially the same, modified only by the intensity of the cause, and by the prevailing constitution. The marked exemption from the disease of the natives of districts where yellow fever is endemic, with their liability to mild intermittent and remittent attacks, is regarded as supporting this view.

The following facts have been cited to sustain the opinion that yellow fever arises from miasmata. 1. It always appears simultaneously with bilious remittent. 2. A high range of temperature is essential to the generation of its cause. 3. Its first appearance is almost always in the lowest and most filthy parts of towns; and in localities favourable to the production of miasmata. 4. The supervention of storms, heavy rains, or cold weather puts an immediate check to its progress.

With some writers it is still even a disputed question whether certain fevers which have, or are supposed to have, their source in vegetable miasmata, or in effluvia from marshes, or from infusoria or fungi, developed and propagated under certain combinations of heat, moisture, and putrefying vegetable and animal matters, are subsequently spread by contagion; whilst other writers contend that within the tropics yellow fever may at any time, under certain conditions of moisture and temperature, arise *de novo*, in the impure atmosphere of the crowded and filthy ship or city. Others again as strenuously uphold the doctrine that yellow fever is a specific, contagious, pestilential disease, which, like small-pox or measles, may be transferred and communicated from one ship or city to others, thus following the great avenues of commerce. A third class adopt and advocate a doctrine which embraces the main features of both propositions. Some who hold that yellow fever may be engendered *de novo* in the holds or atmosphere of ships navigating in the warm, moist, tropical regions, have coupled with this view the doctrine that if this poisoned atmosphere be allowed to escape at the wharves of cities situated beyond the yellow fever zone, those only who come within the sphere of its influence will be affected, and its subsequent spread will depend upon conditions of filth and crowding of such localities, the disease never spreading endemically, but falling harmless among the inhabitants of a salubrious locality. According to this view, the development of this malignant fever requires the conjoint operation of both local and general causes, constituting an endemico-epidemic which is unsusceptible of propagation by specific contagion, and in the summer atmosphere of a city lying beyond the yellow-fever zone there must exist some peculiar combination of circumstances, or some peculiar agency, favourable to its development. In these cases it is affirmed that there is generally found an infected district, which slowly and regularly extends its boundaries, rendering all who come within its limits subject to this form of fever.

It has been said that the experience of several centuries leads to the view that the cause of this fever is perennially present in the tropical and subtropical cities of America; that it maintains the same relation towards the human system as the other malarial emanations of swamps and low lands; and that it is liable to be developed at any time, in different degrees of intensity, by the combined operation of heat and other agents. Amongst the most striking circumstances in the ætiology of yellow fever are the marked geographical

boundaries within which it is confined, and the circumscribed localities in which it prevails; its more frequent prevalence in the western than in the eastern hemisphere; its almost universal limitation to commercial sea-ports, elevated but a few feet above the level of the sea, although it occasionally spreads to towns and cities in the neighbourhood of the latter, situated in the interior of the country, on the banks of navigable rivers; and the fact that it is very frequently circumscribed within certain limited and well-defined portions of the locality or city in which it prevails. To these may be added the vastly greater susceptibility of strangers over the natives of regions in which the disease is endemic, although this susceptibility is liable to diminution by residence in the proscribed regions.

Anatomical Characters.—In cases of death from yellow fever the features are frequently bloated; the skin of the face and upper part of the trunk of a golden-yellow colour; whilst dependent parts present a mottled purple, and a yellow ecchymosed appearance. Considerable quantities of dark fluid blood escape on section of the muscles, becoming bright scarlet on exposure. Putrefactive changes set in early, appearing sometimes to do so before death.

The *nervous system* presents no characteristic appearances beyond general congestion. Urea, bile, and leucin have been obtained, by analysis, from the brain.

The *heart* is in a condition of acute fatty degeneration, of a pale yellow or brownish-yellow colour. This degeneration is more extensive and more rapid than in any other disease. The cavities are usually filled with dark fluid blood, which contains an excess of urea, ammonia, and extractives, with a great diminution of fibrin. No such appearances are found in the heart in malarial fever.

The *lungs* present extreme congestion of dependent portions, and sometimes circumscribed hæmorrhages into the pulmonary tissue.

The mucous membrane of the *stomach* is frequently intensely congested, softened, and eroded, often containing large quantities of black vomit of an alkaline reaction, from the presence of ammonia, resulting from *ante-mortem* decomposition of the urea. Microscopically the vomit is seen to contain red blood-corpuscles, gastric epithelial cells, dark masses of hæmatin, and sometimes vibriones and other organisms.

The *intestines*, as a general rule, are dark-coloured and distended with gas, sometimes containing large quantities of dark altered blood, of an alkaline reaction. Bile is always absent from the intestinal contents. Intussusception of the bowels is by no means unfrequent.

The *liver* is yellow and bloodless, and the stroma and secreting cells are infiltrated with fat, though the organ is firmer than is the case in ordinary fatty degeneration. None of the pigment deposited in the portal capillary system in malarial fevers, is found in yellow fever. When yellow fever has been preceded by or engrafted on malarial fever, the liver presents the appearances of both these diseases, and hence some confusion has occurred in the recognition of the normal pathological appearances proper to each. The golden-yellow colour of the yellow-fever liver can be extracted both by alcohol and water. A similar decoction of the malarial liver is of a brownish-yellow colour; in the latter case also the organ is softer, contains more blood, and is readily dissolved by liquor potassæ, forming a solution of the appearance of venous blood, which is not the case in yellow fever. Large quantities of urea and fat, as well as glycogen and glucose, may be obtained from the yellow-fever liver, whilst, as a general rule, grape-sugar is absent from the malarial form.

As a general rule the *gall-bladder* is contracted and flaccid, and contains but very little bile; but sometimes it is distended with dark grumous blood, and occasionally an albuminous mucoid liquid, without a trace of bile. In malarial fever, on the contrary, the gall-bladder is usually full of dark greenish-black bile.

The *spleen* is but slightly enlarged as a rule, and is frequently normal in size and appearance, internally as well as outside.

The *kidneys* are of a brownish-yellow colour, and loaded with fat. The Malpighian corpuscles and tubuli uriniferi are filled with granular albuminoid and fatty matter, detached epithelial cells, and oil-globules.

The *urinary bladder* is almost always empty; the little urine that it may contain is of a light yellow colour, free from crystalline deposit, and loaded with albumen.

Symptoms.—*Invasion.*—The symptoms of yellow fever at this stage are uncertain and ill-defined. Attacking a community, as this disease does, without discrimination of age, sex, or state of health, those only being exempt who have already suffered from the malady, it of necessity offers the greatest variety of manifestations. The onset, as occurring suddenly in apparent health, is marked by intense headache, rigors, pain in the limbs and back, rapid rise of temperature, eyes glistening and suffused, congested countenance, intense thirst, anorexia, uneasiness at the epigastrium, nausea, and vomiting.

*Stage of chill, or primary depression.*—Here, also, the symptoms are not uniform. In some cases, and even in those of the greatest violence, chills are entirely absent, or amount only to a sense of coldness. In others they are deep, penetrating, and stupefying, or alternate with flashes of heat and crawling sensations; or the constriction of peripheral vessels may be extreme, causing a shrivelled appearance of the skin. In some cases, again, the disease is ushered in by giddiness, and in others with convulsions. Neither the presence nor absence of chills, therefore, can be regarded as characteristic. The chills, when they do occur, differ from those occurring in true malarial fever, and rather resemble those which may take place at the onset of such diseases as small-pox or pneumonia.

*Stage of reaction.*—The stage of active febrile excitement follows the chills, or the premonitory symptoms of uneasiness, prostration, and languor, with severe pain in the head and limbs, in the form of a rapid elevation of temperature. This ranges in the first day of the disease, according to its severity, from 102° to 110° Fahr. in the axilla; and it is probable that the internal organs attain in some cases a temperature of 112°. As a general rule, from the third to the fifth day it falls to

the normal standard, and even below it; in some fatal cases it rises again towards the end, rarely, however, exceeding 104° Fahr., and never attaining the high degree reached at first. The supervention of any inflammatory condition, or the occurrence of an abscess, will also cause a rise of temperature, with slight evening exacerbations; but as a rule the secondary elevation thus caused never equals the maximum of the stage of active febrile excitement. When malarial paroxysmal fever is engrafted upon yellow fever, in its later stages, or during the period of convalescence, the temperature during the hot stage may even exceed the maximum of that of yellow fever, but it will be characterised by sudden periodic depressions and elevations recurring at definite intervals. The pulse when reaction has set in is rapid, strong, tense, and full, though occasionally feeble and compressible. The increase of the frequency of the pulse does not however, as a general rule, continue to correspond with the elevation of the temperature; and in many cases the remarkable phenomenon is witnessed of the pulse progressively decreasing in frequency, and even descending below the normal standard, while the temperature is maintained at an elevated degree. This singular circumstance is of great diagnostic value, as serving to distinguish yellow fever from other diseases, and especially from malarial paroxysmal fever, and also as indicating the presence in the blood of a poison possessing a specially depressing influence on the heart. On the other hand, the pulse may increase in frequency, but diminish in force, near the fatal issue, with a fall in temperature, particularly if there have occurred free hæmorrhage from the stomach.

The stage of febrile excitement is not of fixed duration, and may in some of the gravest cases appear to be comparatively mild and unimportant. At the same time the pains may be so slight and there may be such an absence of delirium, and but small failure of strength, that both patient and physician may be deceived, and yet the former may die without taking to his bed. In most of these so-called 'walking cases,' the kidneys have been involved from the inception of the disease, and complete suppression of the urine has supervened before death. This latter symptom is almost invariably fatal, and is a chief cause of the hæmorrhages from the stomach and bowels, and also of the marked blood-changes, leading to severe nervous disturbances, and frequently to sudden death. There is no doubt but that the fever-poison directly interferes with the nutrition of the gastro-intestinal mucous membrane, liver, and kidneys, loading thereby the already vitiated blood with the abnormal products of their disintegration, whilst the circulation of the impure blood necessarily affects all the tissues of the body, and intensifies the morbid changes in those organs primarily attacked by the specific poison. The action of the poison of yellow fever, during the stage of acute febrile excitement, is manifested not only by intense pain in the head and back, and the florid congestion of the eyes and skin, the anorexia and nausea, the pyrexia and increased frequency of pulse, but also by the albuminuria, which is rarely entirely absent in severe cases, and may make its appearance on the first day of the febrile state.

The congestion, so marked upon the conjunctiva and skin, extends also to the internal organs, and is well seen in the injected nares, crimson lips, scarlet tip and edges of the tongue. As a general rule, in the stage of febrile excitement the tongue is pointed, red at the tip and edges, and coated with thick white and yellow fur in the centre and over the roots. After the febrile excitement has continued for over three days, in some cases the tongue may present a corrugated, cracked, and bloody appearance. We never observe in specific yellow fever the broad tongue with indented edges, which often characterises the prolonged action of the malarial or paludal poison. The gums are red, spongy, and often bleed upon pressure, and the fauces brilliantly congested. The fact that mere examination of the throat and depression of the tongue is sufficient to cause nausea and retching, is an important diagnostic sign.

*Stage of depression and exhaustion.*—In cases which terminate favourably, the deleterious substances generated during the stage of febrile excitement are gradually eliminated, and the organs especially affected by the poison resume their healthy actions. In those cases which end fatally at this stage, the issue appears to be mainly determined by heart-failure from acute fatty degeneration, as well as the profound blood-changes induced by the specific poison, and the retention of the secretions of the liver and kidneys, the functions of which are arrested. There appear to be no just grounds for the subdivision of this fourth stage, in accordance with the presence or absence of hæmorrhage, coma, jaundice, uræmic poisoning and convulsions, for these are simply effects and aggravations of the preceding symptoms, and must be regarded as the maximum phenomena of the stage. Neither is this stage to be regarded as similar to, or identical with, the intermission or remission of malarial fever, or as an abortive repetition of the febrile stage, in which the disease ends from adynamic incompetency to carry out the phenomena.

*The black vomit.*—The ejection of altered blood from the stomach—black vomit—during the period of depression, although not absolutely characteristic of yellow fever, is still of such frequent occurrence as to demand special consideration, both of its nature and origin. The character of the matters vomited varies in different stages of the disease, as also with the degree of its severity. Whilst yellow fever is characterised, in common with several other diseased states, by an irritation of the gastric mucous membrane, the peculiar nature of the vomited matters does not rest entirely upon this irritation and congestion, but is influenced to a greater or less extent by the changes in the blood, liver, kidneys, and nervous system. The vomiting also may be regarded as, to a certain extent, salutary, and as an effort for the elimination of excrementitious materials from the blood. For in some cases distinct improvement follows the vomiting, as seen in the abatement of the pyrexia, and the cleaner condition of the tongue; and it would almost seem that, were it not for the profound changes in the blood and organs lying at the back of this almost

universally fatal symptom, recovery might start from its occurrence. The first ejections generally consist of the ordinary gastric secretions, followed by a mucoid fluid, which is frequently at first tinged with bile, sometimes of an acid, sometimes of an alkaline reaction. The acidity is not due to the presence of any peculiar acid, but to hydrochloric or lactic acid, and is mainly determined in intensity by the nature of the ingesta. After the first vomiting the stomach may remain tolerably quiet until the subsidence of the fever on the third, fourth, or fifth day, when, without any premonitory symptoms of nausea, the stomach, on any trifling provocation, may eject a quantity of clear, pale, almost limpid, and slightly acid, opalescent fluid. At this period the disease may terminate, as if this excretion were similar to the perspiration of intermittent fever. If the vomiting continue, it becomes first streaked with dark flocculi of altered blood, and acquires an alkaline reaction, due to carbonate of ammonia, arising from the decomposition of the urea, which is eliminated from the gastric mucous membrane. The black vomit varies in specific gravity from near that of distilled water to that of blood; and it consists of the secretion of the mucous membrane, mixed with food, altered blood, epithelial cells, and excrementitious products, such as urea and carbonate of ammonia.

*The urine.*—The reaction of the urine is invariably acid, even in the gravest cases. As a rule, the specific gravity ranges from 1,009 to 1,028. In those specimens of the highest density the increase appeared to be due to the amount of albumen. During the early stages of the disease, the urine is normal in colour, clearness, and quantity; as the disease proceeds it becomes of a deep yellow colour, from the admixture of bile; and on the fourth or fifth day appears turbid from the presence of renal epithelial cells, tube-casts, and yellow granular albuminoid matter. The colour may deepen to orange-red, or even to reddish-brown; and the urine sometimes presents an oily appearance. The quantity may be much diminished, up to complete suppression. As a general rule, the amount is diminished in the active stages of the fever. If the case advance favourably the urine is copious, and the colour progressively increases in depth even to almost black. In grave cases it is much less abundant, and at the same time of a much lighter colour. Albumen is an almost invariable constituent, and may appear as early as the first day of the disease, but most generally from the second to the fifth. When convalescence is protracted, the albuminuria may continue long after all symptoms but debility have left the patient. When precipitated by heat or nitric acid, the albumen appears of a golden yellow or light brownish colour. As much as one ounce of dried albumen has been excreted in twenty-four hours, representing the albumen of nearly one pound of blood. Associated with the albumen are renal epithelial cells, and casts of tubules, but the albuminuria must not be wholly referred to an acute desquamation of the excretory cells, nor to mere capillary congestion, but is equally due to chemical changes effected by the poison of yellow fever in the albumen and fibrin of the blood. The albumen appears in large amount in the urine, in cases where there is no apparent failure in the excretory action of the kidneys, and in which the urine is abundant, and laden with urea, as well as bile. The presence in the urine of red corpuscles and the colouring matter of the blood is not so characteristic in this disease as in the so-called malarial hæmaturia, where renal casts and epithelium may occur in considerable amount, but with only sufficient albumen to correspond to the exuded blood; whilst in yellow fever, when blood does appear in the urine, the amount of albumen is much greater than could thereby be accounted for. In the former disease also, the urinary casts contain red corpuscles, and are of a brownish colour, in place of the golden-yellow tint which these oil-laden bodies present in yellow fever.

Throughout the disease, when there is no suppression, the amount of urea is much increased, reaching as much as a thousand grains *per diem*. There is a similar increase in the phosphoric and sulphuric acids, up to as much as fifty and sixty grains respectively.

Pathology.—The various manifestations of yellow fever, as the intense capillary congestion, cardiac depression, delirium, coma, and convulsions, vomiting, hæmorrhage, urinary suppression, and jaundice, may all be referred to the action of the specific poison, and should not be erected into distinct types of disease, however prominent any one of these symptoms may be, and however much cases may differ from one another. The action of the yellow-fever poison is the same in all cases, whether mild or severe; the progress and termination, and the manifestation of the various symptoms, depending on the degree of action of the poison, the condition of the system at the time of its introduction, the peculiarities of constitution, the various agencies to which the patient is subjected during the course of the disease, and the supervention of other maladies.

Yellow fever, according to this view, partakes of the nature of a continued pestilential fever, presenting two well-defined stages: the first characterised by active chemical change in the blood and organs, attended with elevation of temperature, which may constitute the entire malady, and prove fatal in a manner similar to other acute specific fevers; the second, or stage of depression, resulting from the action of the poison, and the blood-changes induced by the suppressed functions of certain organs.

From a consideration of the foregoing symptoms, it is manifest that the blood must have undergone profound changes, which seem to consist chiefly of the following:—

1. Such an alteration of the chemico-physical properties of the fibrin and albumen, as leads to the transudation of the latter, through the excretory structures of the kidney.

2. Various degrees of diminution of the fibrin, in some cases amounting to almost entire disappearance; and this apparently due more to the direct action of the specific poison than to the retained urea, bile-acids, &c. As a result the blood coagulates imperfectly; and the clot is soft and bulky, exuding but little serum, and often breaking down on standing into a grumous fluid.

3. Whilst the red blood-corpuscles are not specially diminished, they are much altered in appearance.

4. Increase of fatty and extractive matters.

5. Accumulation of the biliary constituents, as shown by the golden-yellow colour of the serum.

6. Accumulation of the urinary constituents, especially the urea, carbonate of ammonia, chloride of sodium, and phosphoric and sulphuric acids. The alkaline reaction of the blood during life rapidly changes after death to acid.

7. Rapid dissolution of the red blood-corpuscles, with corresponding diminution of their oxygen-carrying power.

8. Rapid putrefraction, after its abstraction from the body.

The various causes of black vomit may be thus summarised:—1. The irritation and structural alteration of the gastric mucous membrane, which is a part of the general tissue-degradation, consisting of granular and fatty degeneration of the secreting cells and of the walls of the smaller blood-vessels and capillaries, as well as the general congestion of the organ. 2. The changes in the blood, especially the marked diminution of the fibrin. 3. The suppression of the action of the kidneys, and the retention in the blood of urea and similar bodies. It may be noted that black vomit rarely occurs in those cases where the kidneys act continuously and freely. 4. The direct irritation of the urea and its derivatives, which are eliminated vicariously from the gastro-intestinal mucous membrane. 5. The irritant, nauseating effects of the bile retained in the blood.

In yellow fever, acute atrophy of the liver, and acute phosphorus-poisoning—diseased states which have many symptoms and pathological lesions in common—it would seem that the oxidation of albuminoids is not so complete as in health, and besides the formation of leucin, tyrosin, and other similar bodies, a large amount of fat is produced, which may extensively infiltrate the tissues. It is clear that one effect of suppression of urine is to determine the retention in the blood of a large excess of urea. This may in part be eliminated by the gastro-intestinal mucous membrane, and the black vomit may be intensely alkaline from carbonate of ammonia derived from this substance; and it is further evident that in many cases of yellow fever the fatal issue is determined chiefly by the retention in the blood of the constituents of the urine. To the same cause also must be attributed, to a great extent, the nervous irritation, delirium, convulsions, and coma which characterise the stage of depression. Certain of the blood-changes may be referred also to the same cause.

Duration.—The several stages of yellow fever which have been described are not uniform in their duration, and there may be a marked diversity in the manifestation of the symptoms in individual cases, some presenting apparently but the stage of febrile excitement, whilst others, overwhelmed as it were by the poison, at once pass into a condition of hopeless prostration. In mild cases, especially in children, the disease may be so slight as barely to attract attention, and convalescence may be established in two or three days. The stage of febrile excitement may continue from two to six days, rarely beyond three or four, and the patient may pass almost imperceptibly into convalescence during the stage of depression. The severest cases may prove fatal in two or three days, with an axillary temperature of 110° Fahr.; or later from hæmorrhage, urinary suppression, general prostration, or an adynamic state, accompanied with parotid abscess, revival of old complaints, or the supervention of some other disease, such as malarial fever. The fourth stage may be of long duration, extending over weeks and even months. It is, however, true that convalescence is usually comparatively rapid, and in striking contrast to the tedious recovery from malarial fever. In some cases vomiting may be the prominent symptom; in others hæmorrhage from the stomach and bowels, or from the gums, eyes, and ears; in others, again, the cerebral symptoms may be most marked.

Terminations and Mortality.—In fatal cases death may be referred to a variety of causes, namely:—1. The direct action of the fever-poison upon the blood and nervous system. 2. The disturbance or suppression of function of certain organs, as the kidneys and liver. 3. Syncope from cardiac degeneration. 4. Profuse hæmorrhages from the stomach and bowels. 5. Blood-poisoning from absorption of putrid black vomit in the stomach. 6. The formation of abscesses with sequential pyæmia.

The mortality occasioned by yellow fever appears to be as great as that caused by any known epidemic or endemic disease, and varies in different localities and epidemics from 10 to 70 per cent. of those attacked.

Prognosis.—Continuous observations of the temperature should be made, as by that means prognosis and treatment may best be regulated. If the axilla temperature rise in the first stage above 105°, the patient is in imminent danger; and if it reach from 109° to 110° death is almost inevitable. Cases however have recovered in which the temperature has reached the latter point. When the temperature rapidly rises to 106° and upwards, death sometimes occurs suddenly, and apparently solely from the effects of the high temperature upon the blood, heart, and nervous system, as in sunstroke.

Treatment.—1. *Prophylactic.*—Experience has established the possibility of excluding yellow fever from localities in which it has prevailed as an epidemic, subsequent to introduction from other regions, by means of an absolutely strict quarantine. But, hitherto, it has been almost impossible to arrive at any definite conclusions as to the value of quarantine in those regions in which the disease is endemic and indigenous.

Much difference of opinion has existed as to the value of disinfectants, such as chlorine, carbolic acid, and sulphurous acid. In arresting the spread of the fever it is very doubtful whether much of the benefit that has been attributed to them is not rather to be ascribed to other causes; and, in estimating the value of any such sanitary measures, the following facts in the history of yellow fever should be considered:—

(*a*) Yellow fever may prevail in one or more cities, and at the same time be entirely absent

from other cities in the same zone, and subjected to very nearly the same hygienic conditions. The mere absence of yellow fever from a particular city, whilst it is prevailing elsewhere, proves nothing as to the mere sanitary condition and measures of the city enjoying the immunity.

(*b*) One of the most essential elements for the origin and spread of yellow fever within and immediately around its recognised geographical limits, is the influx of strangers and immigrants, or an unacclimatized population.

(*c*) It is not provable that a wide-spread epidemic would ever arise in a city within the recognised zone, in which the vast proportion of the inhabitants are acclimatized, and have been subjected to the action of the specific poison.

(*d*) Yellow fever has been entirely absent from many cities, where serious epidemics have occurred, during long series of years; and at other times has prevailed to a very limited extent, and with but slight mortality, when no disinfectants have been used.

2. *Curative.*—Yellow fever is a 'self-limited' disease, and cannot be arrested by drugs. Every case should be regarded as serious, however slight the symptoms may appear; and on account of the structural alterations in the blood and organs, the closest medical attendance and most careful nursing are required. Since so many of the symptoms are due to arrest of the functions of the skin and kidneys, efforts should be directed to promote the activity of these organs during the progress of the disease. Stimulant diuretics should, as a rule, be avoided, but benefit often follows the free use of hot mustard foot-baths, vapour baths, and sometimes warm baths. Diaphoresis and diuresis may be further promoted by large draughts of lemonade, decoctions of orange leaf and sage tea, and water charged with carbonic acid. Absolute rest in the recumbent posture must be maintained as far as possible. The necessity for this is especially indicated by the cardiac weakness, fatal results having followed rising from bed and walking during the period of calm.

The maintenance of free ventilation, and the avoidance at the same time of sudden changes of temperature, by proper coverings, is essential. Experience shows that many fatal cases from urinary suppression have followed sudden changes and falls of temperature. Each case of yellow fever should have at least 2,000 cubic feet of space; and hospitals, where practicable, should be constructed on elevated situations. All discharges should be immediately removed from the sick-room; the bedding frequently changed; and the soiled clothing boiled, or baked at a temperature of not less than 230° Fahr.

The practice of covering patients with heavy blankets, and at the same time giving large quantities of hot drinks, with the object of inducing profuse sweating, frequently appears to be injurious, not only from the debilitating effect, but also from the greater susceptibility of the skin, and the increased tendency to renal congestion thereby induced.

The diet should be light and nutritious. Beef-tea, chicken-tea, corn-flour and rice gruel, barley water, iced milk, and milk and lime-water are the best forms of nourishment, and should be continued at regular intervals throughout the active stages of the disease. Solid food and even bread should be avoided.

In many cases the preceding measures, accompanied by absolute rest in bed, and the careful and continuous attention of an experienced nurse, will be all that is required.

Alcoholic stimulants should be used with caution. They have proved beneficial in cases attended with great prostration, champagne appearing to be the best form.

The treatment for hyperpyrexia consists in the giving of such cardiac sedatives as aconite, veratrum viride, or gelseminum; the injection of large quantities of ice-cold water into the rectum; sponging the surface with cold water, or with water, acetic acid, and alcohol; and blood-letting. It appears also that an active purgative, such as calomel or castor oil, followed immediately by one or two full doses of quinine in the first twenty-four hours of the fever, may reduce the temperature.

Efficient but gentle purgation in the early part of the first stage may be beneficial. Mercurials should not be given later than the second day for an adult; eight to twelve grains of calomel or blue pill, or an ordinary dose of castor oil, will be sufficient. Purgatives, as a general rule, should not be administered in the stage of depression. An emetic may be useful at the very beginning, if the stomach be loaded. Local blood-letting, whilst of occasional benefit for the relief of congestion in the first stage, is most injurious later. Dry-cuppings and sinapisms are usually sufficiently effective.

The internal administration of the mineral acids or the tincture of the sesquichloride of iron, from their supposed beneficial effects upon the jaundice and black vomit respectively, is of doubtful propriety, and sometimes directly injurious.

The value of quinine in yellow fever is not nearly so great as in paroxysmal malarial fever; and notwithstanding statements to the contrary, the writer fails to discover any facts or cases by which the power of large doses of quinine to abort this disease can be fully and unequivocally established, though its efficacy, not only in arresting, but in warding off paroxysmal fever, is undoubted. It is rather as an antidote to the effects of the poison, than to the poison itself, that quinine is of use.

Opium, in whatever form, should be administered with great caution, from its poisonous effects when the kidney-action is arrested, but may be of advantage when sleeplessness and restlessness are prominent. Arrest of the function of the kidneys, owing to the grave alterations in their structure, is beyond relief by drugs. The tincture of ergot, which has been recommended, has often failed; but much good has been accomplished, and the function of the kidneys restored, by the injection at regular intervals of a pint or more of ice-cold water into the rectum.

When there is a threatening of black vomit ice should be swallowed, and bags of the same applied to the epigastrium. Septic poisoning has been known to follow decomposition of the blood effused into the gastro-intestinal tract, and to

prevent this, scruple doses of sulpho-carbolate of soda, repeated every three or four hours, have been given with advantage.

During the period of calm, active medication, beyond what has been indicated, should be abstained from. The diet should still be of the simplest, most nutritious, and most digestible character. In this stage there is often a morbid craving for food, and in some instances relapse and death have been the result of the unrestrained indulgence of the appetite.[1]

JOSEPH JONES.

# Z

**ZINC, Poisoning by.**—SYNON.: Fr. *Empoisonnement par le Zinc*; Ger. *Zinkvergiftung.*

Poisoning by compounds of zinc is rare, if we except poisoning by the chloride (Sir W. Burnett's Fluid), which acts as a corrosive poison, like the mineral acids (*see* POISONS). Zinc sulphate (white vitriol) is the only other salt of zinc of importance from a toxicological point of view; this salt has proved fatal in a few instances.

ANATOMICAL CHARACTERS.—These are of the same nature as those of the mineral irritants—gastro-intestinal inflammation, ecchymoses, and softening. Ecchymoses have also been observed in the pleura.

SYMPTOMS.—The symptoms of poisoning by zinc are similar to those produced by tartar emetic. They include an astringent, metallic, and burning taste in the mouth; early and violent vomiting; pain in the abdomen; purging; great prostration and anxiety; a small and feeble pulse; shallow respirations; cold perspirations; and collapse and exhaustion, ending in death. The intellect is unaffected.

DIAGNOSIS.—In the absence of any history of the administration of zinc sulphate, the diagnosis cannot be made between this and other forms of irritant poisoning, such as by blue vitriol, except by the aid of chemical analysis.

PROGNOSIS.—The prognosis of zinc-poisoning is generally favourable.

TREATMENT.—Demulcent drinks, sedatives, and alcoholic stimulants should be immediately given. The administration of a solution of the common phosphate of soda, largely diluted, is advisable. It acts as an excellent precipitant of zinc, in the form of an insoluble phosphate. Opiate enemata may prove serviceable.

THOMAS STEVENSON.

**ZONA or ZOSTER** (ζώνη, a girdle).—SYNON.: Shingles; Fr. *Zona;* Ger. *Zoster; Gürtelrose.*

This term applies correctly only to that form of herpes which runs round one half of the trunk of the body, usually in the region of the waist. In other situations the eruption is named in accordance with the region; for example, *Herpes facialis; H. collaris; H. brachialis; H. cruralis;* &c. Latterly, however, the term zoster has crept into our dermatological literature as a generic appellation, and we read of *Zoster facialis, brachialis,* &c., names which philologically are evidently inaccurate. *See* HERPES.

ERASMUS WILSON.

**ZYMOTIC: ZYME** (ζυμόω, I ferment: ζύμη, ferment).—SYNON.: Fr. *Zymotique: Zymase,* Ger. *Gährungsfähig: Gährstoff.*—The terms *zyme, zymine, zymotic,* and *zymosis* were introduced by Dr. Farr, in a letter to the Registrar-General in 1842, and employed by him to denote, in a general way, the poison (and pathological processes excited by it) of 'epidemic, endemic, and contagious diseases.' In using the word ζύμα, he was careful to point out that he did not consider the morbific process to be absolutely identical with the ordinary phenomena of fermentation, and that he wished the terms *zymosis, zymotic,* &c., to be employed in English, 'not in

[1] In the epidemic of yellow fever in New Orleans during 1878, when, in a population of 210,000 the deaths numbered 4,056, the writer had an extensive experience of the disease, himself treating 256 cases, of whom 18 died. The plan of treatment was based upon the preceding principles. The alimentary canal was cleared at the outset by an emetic of ipecacuanha, and a powder of 10 to 20 grains each of calomel and quinine, followed by a full dose of castor oil. The action of the skin was excited by hot mustard foot-baths and mild diuretics. The function of the kidneys was maintained by the regular use of cold water, by attention to the covering of the patient, and avoiding cold currents of air. Absolute rest, in all cases, in a well-ventilated room, for from eight to fourteen days, or even longer, was strictly enforced, supplemented with careful nursing night and day, and the most exact record of the progressive state of the patient. During the period of febrile excitement the patients were confined to barley water. When the initial temperature was high, 2 to 4 drops of tinctura veratri viridis, or 5 to 10 drops of tinctura gelsemii were administered every two or four hours, combined with friction with a liniment composed of from 1 to 2 drachms of the sulphate of quinine mixed with 3 fluid ounces each of soap liniment and olive oil. Ten grains of sulpho-carbolate of soda in orange-leaf tea were given every four hours. Where the head was very hot and there was much nervous irritability, cold applications were employed. Gastric irritation was treated by sinapisms to the epigastrium, with carbonate of lime and creasote internally. Except in cases attended with great nervous excitement, without urinary suppression, opiates and chloral were not given; but in such cases they were apparently beneficial. Cupping over the loins and bromide of potassium were used when the urine was diminished in quantity. After the subsidence of the febrile excitement, iced champagne and beef-tea were administered in small quantities, at regular intervals. In cases which assumed the 'typhoid state,' attended with tympanites, ice-cold enemas, containing small quantities of tincture of assafœtida and oil of turpentine, were found to be beneficial, by reducing the temperature, stimulating the bowels to expel the flatus, and promoting the action of the kidneys. When secondary fever ensued, and presented an intermittent or remittent type, the sulphate and bromide of quinine were freely used. And when the stomach would tolerate nourishment and stimulants, beef-tea, chicken tea, beefsteak, and port wine or brandy were administered. When convalescence was prolonged, or life endangered by abscesses or carbuncles, iron and other tonics were given, together with a nutritious diet, and the local application of carbolic acid, tincture of iodine, &c. Relapses were avoided by confining the patient to bed until the heart had regained its usual vigour.

the sense which they have in Greek, but as general designations of the morbid processes and their exciters.' With this qualification clearly expressed, the use of the root-form ζυμ- has become general, not only in scientific literature, but also in the public press—almost invariably, however, in the adjectival form *zymotic*.

Fourteen years later (1856), in the *Sixteenth Annual Report of the Registrar-General*, Dr. Farr described the diseases of the zymotic class as conveniently referable to four groups. These are:—1. The *Miasmatic*, diffusible through the air or water, attended by fevers of various forms; the matter by which they are communicated is derived from the human body, as in small-pox, or from the earth (as in ague). These two diseases are types of this class. 2. The *Enthetic* diseases, which may properly be called *contagious*, being communicated by contact, puncture, or inoculation. Syphilis and glanders are types of this class. 3. The *Dietic* diseases, which arise when the blood is supplied with improper or bad food. Scurvy and ergotism are the types of this class. 4. The *Parasitic* diseases, which attack especially dirty populations, and infest the skin, the intestinal canal, and all the structures of the body.

This classification is open to serious objections. It is quoted here rather because it continues to be employed in official reports, than on account of its intrinsic importance. Modern pathology will probably soon necessitate its revision.

Recently, indeed, the word zymotic has been restricted to the acute specific diseases, included under the first group (miasmatic) in the above classification; and at the present time it is in this limited sense that it is most commonly used.

Another important application of the term must now be referred to. Within the last few years the root-form ζυμ- has been introduced into the terminology of normal physiology by Heidenhain in Germany, to designate the active substance (precursor of trypsin, &c.), contained in gland-cells as *zymogen*, which develops the ferment by its metamorphosis. Thus, unfortunately for the purposes of exact description, the same root-form is employed by pathologists and physiologists to designate two apparently distinct processes. Although the intimate relationship of these two processes was recognised as early as the seventeenth century, by such authorities as Sydenham and Morton, they cannot at present be considered identical, notwithstanding the fact that the similarity becomes more striking with every fresh addition to experimental physiology.

Corresponding with the adjective *zymotic* is the substantive *zyme*. This is a useful name, by which we refer to the poisonous cause of zymotic diseases. It is simpler than the word *zymine*, originally proposed by Dr. Farr; and (what is much more important) to speak of the contagious poison as 'a zyme,' does not imply the acceptance of any particular theory of disease, while, on the other hand, the use of the word 'germ' distinctly conveys the idea of some organised structure, itself the cause of the disease by subsequent growth and multiplication. *See* GERMS OF DISEASE.

The necessity for employing the word *zymosis* does not seem to be felt as yet; but the same reasons that lead us to speak of the agent as a zyme should also guide us to use *zymosis* in the place of more usual periphrases.

ANALOGY BETWEEN FERMENTATION AND INFECTIVE PROCESSES.—Such being the derivation of the word *zymotic* and the terms related to it, it is natural to inquire how far an analogy can be traced between the life-history of the diseases thus designated, and the process of fermentation. This subject, which has an important bearing upon the doctrine of contagious diseases, is discussed at length in the article on CONTAGION (page 290).[1] It is there shown how far the two processes resemble each other, and in what respects they appear to be different, at least in some kinds of zymotic disease. It must not be forgotten that fermentation deals with a comparatively simple substance, for instance dead organic or inorganic compounds, and the disease-process with a more complex one, namely, the living animal organism, although the elements of action (the ferment on the one hand, and the zyme or zymine on the other) seem to have identical characters. By interposing the consideration of putrefaction between that of fermentation and zymosis, it is easy to see, from examining the products of each, how similar must be the individual agencies; but, the actual working of the agent in each, or indeed the real nature of each, being unknown, the whole problem remains unsettled.

VICTOR HORSLEY.

[1] Although it is four years since the article CONTAGION was written by Mr. Simon, he has thought it desirable to leave that article unaltered, preferring that it should be supplemented, in respect of the intervening years, by the present article, and others on related objects. In discussing the subject of the organic constitution of the metabolic contagia, Mr. Simon says:—'Though it would be at least premature to say of these diseases' [erysipelas, pyæmia, tuberculosis, enteric fever, cholera, diphtheria, and the smallpox of man and beast], 'that they certainly have as their contagia *microphytes respectively specific* to them, it seems at present not too much to say, that probably such will be found the case. How far these anticipations have already been realised may be learned by reference to the articles BACTERIA; BACILLI (in *Appendix*); MICROCOCCUS; PUSTULE, MALIGNANT; and on the several diseases in which the presence of such organisms has been recognised. *See also* ANTISEPTIC TREATMENT.—ED. (September 1882).

# APPENDIX.

**ACONITE, Poisoning by.**—Synon.: Fr. *Empoisonnement par l'Aconit*; Ger. *Eisenhutvergiftung.*—The common garden-plant, *Aconitum napellus*, known also as 'wolfsbane' or 'blue-rocket,' as well as other species of aconitum, are poisonous, and owe their poisonous properties to the presence of an alkaloid, *aconitine* or *aconitia*, or perhaps to a mixture of alkaloids passing under this name. A similar alkaloid, *pseudaconitine*, has been obtained from the Indian aconite, *A. ferox*; and another alkaloid, *japaconitine*, from Japanese aconite roots. All parts of *A. napellus* are poisonous. The three alkaloids, aconitine, pseudaconitine, and japaconitine, are perhaps the most poisonous alkaloids known. All parts of the aconite plant when chewed, and aconitine when placed upon the lips or tongue, produce, after a few minutes, a disagreeable acrid burning sensation, followed by numbness, loss of sensibility of the part, salivation, and an after-sensation of searedness. These sensations may last for several hours.

The fresh root of aconite has frequently been eaten in mistake for horse-radish, to which it bears a remote resemblance. The root of horse-radish is whitish on the exterior, is long and of fairly uniform diameter, has a pungent odour when scraped, and the scraped surface retains its white appearance; whereas aconite root is brown and conical, is destitute of pungent odour, and speedily acquires a pink colour when scraped and exposed to the air. Mistakes more frequently occur from liniments containing aconite being swallowed in error. In two cases the root has been administered with homicidal intent; and in a recent case a young man was killed by the administration of, as it is supposed, two grains of English aconitine. Accidents have also arisen from the administration of the potent English aconitine in mistake for the impure inert exotic or German alkaloid, or mixture of alkaloids passing under that name.

Anatomical Characters.—After poisoning by aconite there may be gastric congestion or inflammation; but these may be absent.

Symptoms.—When aconite, or any of its preparations, is taken by the mouth, the first sensation, transitory and mainly due to the action of the solvent, is followed in about three minutes by an intolerable burning and numbing pain, extending from the place of application to all the surrounding parts of the mucous membrane. There is salivation; and the burning sensation extends down the gullet to the stomach. Occasionally, when the poison has been rapidly swallowed, no marked symptoms may supervene for half an hour. The general symptoms are very varied, but may all be referred to weakening of the heart's action, disturbances of respiration, and paralysis of sensation on the surface of the body. This last may be described as 'numbness' or 'drawing of the skin,' or by some equivalent term. There is pain in the epigastrium, violent vomiting, occasionally purging; the pulse, at first rapid, quickly diminishes in frequency and force till it is imperceptible; the skin is cold, clammy, and livid; respiration is laboured. The pupils, at first contracted, afterwards dilate; and this dilatation sometimes occurs suddenly and transitorily, and is accompanied by blindness. Convulsions are not common; but vomiting is often due to spasmodic contraction of the diaphragm, causing frothing at the mouth. Consciousness is retained till near the end of life.

Diagnosis.—The peculiar sensation in the mouth—burning, feeling of searedness, numbness, &c.—the great cardiac depression, and the difficulty of respiration, will generally serve to determine the nature of the case.

Prognosis.—Death usually occurs within four or five hours. If the patient survive twelve hours, recovery is usually rapid and complete.

*Fatal dose.*—Of the *root* sixty grains—probably much less might suffice. Of the pharmacopœial *tinctura aconiti* (1 in 8) two or three fluid drachms. *Fleming's tincture* is about six times as strong as the officinal tincture, and twenty-five minims have proved fatal. Four grains of *alcoholic extract* have proved a fatal dose. English *aconitine* or *aconitia* (the alkaloid) is terribly potent: 1-2000th grain will produce a very decided sensation on the tongue, and it is probably as poisonous as the crystallised French aconitine-nitrate, one-sixteenth of a grain of which has killed an adult within five hours.

Treatment.—In proceeding to treat a case of poisoning by aconite we must, first, wash out the stomach by means of the stomach-pump, and promote vomiting by warm emetics, of which carbonate of ammonia is the best. Stimulants must be freely administered; also strong black coffee or tea. Brandy and ether may be injected subcutaneously. Digitalis is a counter-poison, and may be administered with effect subcutaneously, in doses of twenty minims of the

tincture, repeated in an hour or so if necessary. Inhalations of nitrite of amyl may afford some relief. The patient must be kept strictly in the recumbent position, warmth being applied to the surface; and, as a last resort, artificial respiration must be used.

THOMAS STEVENSON.

**AINHUM** (Nat., to saw).—This disease was first described by Dr. da Silva Lima of Bahia in 1867. It is peculiar to the African race, being found not only amongst the inhabitants of the West Coast of Africa, but also amongst the Hindoos of African descent, as well as amongst the slave population of South America. At its commencement, a groove or furrow is seen at the base of the little toe (the part almost invariably attacked), situated on its inner and inferior aspect, and corresponding to the digito-plantar fold. The furrow soon extends to the entire circumference of the toe, and becoming gradually deeper, the latter is left hanging by a slender pedicle, which can only be brought into view by separating the walls of the furrow. The distal portion swells into an ovoid mass, about twice its natural size; finally some accident snaps the pedicle, and the toe drops off, in from four to ten years from the commencement of the disease.

The furrow is caused by a constricting band of hardened and contracted skin—a local scleroderma—which leads to faulty nutrition and degenerative changes in the parts beyond.

Ainhum is not a painful affection in itself, but the extreme mobility of the little toe causes trouble and inconvenience, for which patients often seek relief in amputation.

Occasionally the sides and bottom of the furrow ulcerate; not unfrequently both little toes are attacked by the disease. Males are more subject to it than females. The microscope reveals only atrophic and degenerative changes. The cause of ainhum is entirely obscure. It has been cured by the early division of the constricting band. A. SANGSTER.

**AMBULANCE** (*ambulo*, I walk about).—DEFINITION.—A vehicle for the conveyance of invalid or wounded persons. The term is generally applied to such of these vehicles as are drawn by one or more horses. The French use it to designate a field military hospital.

The writer has described the requirements of an ambulance carriage as follows:—1. Ease of entrance and exit; 2. Freedom from jar during locomotion; 3. Protection against weather, with facilities for regulating air and light; 4. Lightness of structure, consistent with strength; 5. Facility of turning, and of transferring the vehicle to or from a railway-truck or steamship, without disturbing the patient.

Military ambulances are adapted for carrying patients both sitting and lying, along with an attendant; as well as food, water, medicine, and other appliances. In the ambulance designed by the writer, the litter, which is slid noiselessly on india-rubber rollers, rests on a tramway, between which and the body of the vehicle are intermediate counterpoise springs, which intercept shock and jar.

Every ambulance should be provided with a litter-sheet, which can be used without its stretcher poles, for carrying the patient through places too narrow or tortuous for other modes of conveyance. BENJAMIN HOWARD.

**ANÆSTHETICS.**—The two following substances have been introduced as anæsthetics since the article on the subject was written, and call for brief description.

**Bromide of Ethyl** ($C_2H_5Br$).—This substance has been recommended and moderately used as an anæsthetic. Its merits are that it exhilarates and produces rapid anæsthesia. Its effects pass off quickly, without any tendency to depress the action of the heart. The objections to the use of bromide of ethyl are that it is liable to decompose, leaves a strong smell and taste of bromine, and sometimes produces headache and sickness. Two deaths from it in America have been reported. Its use has been abandoned in England.

**Dichloride of Ethidene** ($C_2H_4Cl_2$).—This substance is obtained by distilling aldehyde and pentachloride of phosphorus. The effects of this agent are intermediate between those of chloroform and ether. Its odour is usually preferred to that of either of the former. The writer has used it very extensively; and in minor cases, in which the operation has lasted only five minutes, the recovery is rarely attended by sickness or excitement. In the more prolonged cases it was found to cause vomiting, but this ceased much more rapidly than when chloroform had been given. Its effect upon the heart when given in large doses is depressing, and the pulse should be carefully watched during its administration.

This anæsthetic was used by Dr. Snow, but abandoned chiefly on account of its expense. It was reported upon favourably by the Glasgow Anæsthetic Committee of the British Medical Association. They found that the blood-pressure was diminished by it as well as by chloroform, but that it was more regular in its action, and less potent also, so that they found it much easier to keep a dog alive whilst profoundly under its influence than whilst under chloroform.

**Ether.**—The following point is of importance in connexion with the employment of ether as an anæsthetic. Under ether, bleeding is more rapid than usual; and this may produce syncope when the stimulating effect of the anæsthetic is passing off. To prevent this result, whenever hæmorrhage is likely to be great, temporary ligatures should be applied to the arms and thighs, so as to detain blood in the veins until the chief vessels that have been severed have been tied.

J. T. CLOVER.

**ARKANSAS SPRINGS, in Arkansas, United States.**—Thermal waters. *See* MINERAL WATERS.

**AUSTRALASIA.**—The portion of Polynesia lying between 10° and 50° S. latitude and 110° E. and 170° W. longitude, which may be said to include Australia, Tasmania, New Zealand, the Fiji Islands, the New Hebrides, and some less important islands.

**Australia.**—The climate of the vast conti-

nent of Australia, which is partly temperate and partly tropical, depends, first, on its latitude, and, secondly, on its conformation, the mountain ranges being distributed along the coast lines, especially on the eastern shores. In the interior, which is comparatively flat, and for the most part a sandy desert, there is great heat and little rain. The hot winds from the east are often sufficient in the summer to raise the thermometer to 127° Fahr. There are also sea winds from the N. and N.E. The southerly winds, prevailing chiefly from November to February, are winds of great velocity, ending in heavy thunderstorms. In the tropical part the rainfall is from November to April, and in the temperate, which lies to the east and south, it prevails only in the winter season.

The following are among the principal towns or centres to which invalids proceed:—

*Adelaide*, the capital of South Australia, lat. 35° S., long. 135½° E. It suffers from great heat and drought. The mean temperature is 65°, the maximum 115°, and the minimum 34°; the range being 81°, and the mean daily range 20°. The humidity is 60 per cent., and the rainfall 21 inches. The soil is sandy.

*Brisbane*, the chief town of Queensland, lat. 27½° S., long. 153° E. The climate is almost tropical. The mean temperature is 70°, the maximum 108°, the minimum, 34°; the range 74°, with a mean daily range of 21°. The rainfall is 51 inches, and the mean humidity 76 per cent. Queensland is for the most part elevated; and the climate of the Darling Downs is considered very fine.

*Melbourne*, the capital of Victoria, lat. 38° S., long. 145° E. It has the reputation of being a healthy and agreeable residence; the climate being dry and temperate, and far cooler in summer than that of Sydney. Mean temperature 57°, maximum 111°, minimum 27°, showing a range of 84°; daily range 18°. Mean humidity 72 per cent. Rainfall, 26 inches.

*Perth*, in Western Australia, very healthy, but as yet little suited to the requirements of invalids. The temperature is 63° (mean), and rainfall 30 inches in 110 days.

*Sydney*, the capital of New South Wales, lat. 24° S. and long. 151° E. The climate of New South Wales is clear and dry, the temperature depending more on the altitude than on the latitude. The plains in the interior, swept by hot winds, are very dry, while the coast districts have abundant rain. Mean temperature 62·5°, maximum 107°, minimum 36°; range 71°; mean daily range 14°. Humidity 72 per cent., and rainfall 50 inches.

**Tasmania.**—Tasmania lies 150 miles south of Australia, between lat. 40° 40′ and 43° 38′, and is mountainous, with a deeply indented coastline. The climate is more temperate and equable than that of the south coast of Australia. In winter the cold is sufficient to produce thin ice in the low lands, and snow showers in the higher ranges. The mean temperature of *Hobart Town* on the S.E. coast is 54°, the summer mean being 62° and the winter 47°. The rainfall varies greatly, from 100 inches at Macquarie Harbour on the W. coast, to 24 inches at Hobart Town, distributed over 145 days. The prevalent winds are from the N.E. and S.W. The climate is favourable to infant life, and the country is regarded as a sanatorium for invalids.

**New Zealand.**—New Zealand lies between 34° 50′ and 47° 50′ S. lat., and consists of a North and a South besides smaller Islands. The Northern Island is for the most part volcanic, and abounds in hot springs, which promise to become extensively useful, and active craters, which impart an important influence to its climate. The Southern Island contains a lofty range of snowclad mountains, whose lower slopes form on the eastern shore a series of terraces known as the Canterbury Plains, and other fertile regions.

The climate is mild and bracing, but decidedly of a windy character, and not suited for all invalids; at Auckland in 1876 no calm day was recorded, the prevalent winds being W.S.W. The mean temperature of the North Island is 58°, of the South 54°. The maximum varies from 87° at Christ Church to 75° at Hokitika, and the minimum from 25° to 34° in the Southern Island. Cold is as a rule unknown in the North Island, while in the South there are a few snowy days each year on the coast. The rainfall varies from 32 inches in 135 days at Christ Church, to 131 inches in 186 days at Hokitika.

**Fiji Islands.**—The Fiji Islands, partly of volcanic and partly of coraline origin, have a tropical climate, moderated by the trade winds, so that the mean temperature does not exceed 80°, the minimum being given as 65°. The rainfall is chiefly from October to April—the hot season, and varies from 124 to 215 inches in 170 days.

*See* CLIMATE, Treatment of Disease by.

C. THEODORE WILLIAMS.

**BACILLI** (*bacillus*, a little rod or staff).—SYNON.: Fr. *Baciles*; Ger. *Bacillen*.

DEFINITION.—Rod-shaped vegetable micro-organisms, consisting of single cells, the length of which exceeds twice the breadth.

DESCRIPTION.—The bacilli, thus roughly defined, form a group of algæ which, until lately, were classified under the general terms of *Bacteria* and *Schizomycetæ*. At present, in accordance with the necessities of description, the word bacterium is limited empirically to mean a short rod-shaped organism, whose breadth is not less than half its length; and, moreover, as the term Schizomycetæ does not fully represent the mode of reproduction in the bacilli, its value as a comprehensive term is thereby lessened. It will, therefore, be well to regard bacilli as a distinct order. From differences in their habitat and nutritive requirements, they may be held to be specifically distinct from one another, although this may not be evident morphologically with our present methods of research.

In common with the rest of micro-organisms, bacilli consist of a protoplasmic body, surrounded by a sheath, probably of the nature of cellulose. The protoplasm is albuminous, granular, and occasionally shows brightly refracting fat granules within it; while the sheath or envelope is clear, with a sharp outline, and capable of resisting very powerfully the action of reagents.

The sides of the rod are parallel straight lines in the adult form, while the extremities may be either rounded or square. Notice has been taken of this fact in attempting to establish diagnostic points of difference among the bacilli; but the shape of the extremities varies in the same kind of bacillus, so as to suggest that the rounded end is but an advance on the square surface left immediately after fission of the parent organism.

Although the breadth of each bacillus appears to be constant for the same kind, the length, as may be expected, varies considerably, so that measurements in this direction are of but relative value. The difference of breadth would afford a means of classification, but at present the bacilli are named after the diseases and other conditions with which they are found to be in relation.

Development.—The bacilli multiply by two distinct methods, namely, simple transverse *fission*, and *spore-formation*. The process of *fission*, as it occurs in the adult rod, appears to consist, first, in a contraction of the protoplasm at the centre, followed by an involution of the cellulose envelope, and subsequent separation of the two halves. The rod may grow to twice its length before dividing; but when rapid multiplication is occurring, it is common to find rods of half the adult length. The process of *spore-formation* commences by steady growth of the rod into a long wavy and flexible filament, which, with others, may form a thick felt-work. In the next stage bright points appear in the protoplasm, which increase in size, and, from being first cylindrical in shape, become ovoid, and so form spores imbedded in the filaments. The protoplasmic spore then becomes covered with an envelope similar to that covering the adult rod, and, getting free from the filament, develops into a rod by outgrowth from one end.

Adult Life-History.—The vital changes of the bacilli are similar to those of other vegetable micro-organisms, that is, they require a moderate temperature (30° to 40° C.), a nitrogenous pabulum, and the admission of free oxygen for their full development. The different kinds of bacilli vary with regard to their pabulum; thus one (*Bacillus subtilis*) flourishes best in a hay infusion, where another (*Bacillus anthracis*) finds it hard to live. Diminution of the supply of oxygen leads to abortive growth. With respect to temperature, they are unaffected (as regards actual vitality) by extreme cold, but probably all varieties enter into heat-rigor at 60° C.

Pathological Relations and Classification. The general characters of the bacilli so far have been considered apart from their most important bearing on disease, a preface to which division of the subject will best be afforded by enumerating the kinds of bacilli that have as yet been described. They are as follows:—

Bacillus subtilis } not found in living
„ ulna } animal tissues
„ anthracis
„ malariæ
„ septicæmiæ (experimental)
„ lepræ
„ tuberculosis.

Of these kinds of bacilli, the Bacillus anthracis, found constantly in splenic fever, has been very thoroughly investigated (*see* Pustule, Malignant), and may be accepted as an illustration of the relation borne by the different bacilli to the diseases enumerated in the above list. The conditions under which certain symptoms appear synchronously with definite organisms is discussed elsewhere, and it only remains to draw attention to the nature of the classification, as being purely empirical, and of a temporary character.

Diagnosis.—If it were possible, it would be desirable to show how a bacillus, found in connection with definite symptoms, may be identified as peculiar to a particular pathological process. Morphologically we may arrange the so-called pathogenetic bacilli in terms of their breadth, commencing with the narrowest, in the following order—B. septicæmiæ, lepræ, tuberculosis, malariæ, and anthracis; whilst, as regards length, B. tuberculosis is shortest, and between this and the remainder we may place B. septicæmiæ. But the distinctions here given are only of very general value; and as the bacilli differ somewhat in their reaction to staining fluids, we have in this another point of diagnostic value. Thus, B. tuberculosis can only be shown in tubercular fluids or tissues after these have been treated with a solution of an aniline salt, also containing pure aniline, and then washed in moderately strong nitric acid, a process which would be destructive to the other forms of bacilli. A complete means of diagnosis would rest on their physiological properties, but in the present state of knowledge this is impossible.[1]

Victor Horsley.

[1] Note on the mode of demonstrating bacilli.

1. *In fluids, such as blood and sputum.*—An exceedingly thin layer of the fluid is first obtained, by placing a drop between two perfectly clean cover glasses, which are then separated by a rapid drawing movement, thus leaving a delicate film on each. The fluid is next evaporated to dryness, by passing the cover glass a few times through the flame of a Bunsen burner. The coagulation of the albumen thus effected is an important step in the success of the staining process. The dry film may now be stained, by pouring on it a concentrated solution of methyl-violet, or by floating it on a solution of fuchsin, to which some pure aniline has been added. This solution is prepared by dissolving the dye in equal proportions of alcohol and water, to which $\frac{1}{10}$th part of aniline is added, thus making the solution alkaline. The preparation is then washed with a 10 per cent. solution of nitric acid, until all the colour has disappeared. Finally, it is washed with a concentrated aqueous solution of aniline, to restore the alkaline reaction; or the ground substance may be stained with a fluid of the same chemical reaction, namely, vesuvin or chrysoidin; the superfluous reagent is washed off with distilled water; and the cover-glass mounted (after drying) in Canada balsam, or in a mixture of glycerine, glucose and alcohol, having an index of refraction =1·37. See Brun, *Revue Médicale de la Suisse Romande*, August 1882.

Bacilli can also be shown in albuminous fluids by treating the dried film with a 1 per cent. solution of caustic potash in water. In the case of tubercle, they may be distinguished from the ordinary bacilli of putrefaction by gently re-drying the potash-treated film, and then staining with an aniline dye. Under these circumstances the tubercle bacilli show up distinctly *unstained*, whilst the putrefactive organisms are deeply coloured (Baumgarten, *Centbt. f. d. med. Wiss.* S. 257, 1882.)

2. *In tissues.*—The organs are hardened in alcohol, and very thin sections from these are stained by a similar process to that detailed above In practice it will be found necessary to use a weak solution of acid for the sections; and although the section appears quite white after its removal from the acid fluid, its colour partly returns on washing with water, again to be removed in the subsequent stages of passing the section

**CANTHARIDES, Poisoning by.**—Synon.: Fr. *Empoisonnement par la Cantharide*; Ger. *Cantharidenvergiftung.* — Cantharides or the Spanish fly owes its poisonous properties to the presence of *cantharidin*, a non-alkaloidal body. All the preparations of the drug are highly poisonous.

Symptoms.—Soon after taking a poisonous dose of cantharides, the patient is seized with burning pain in the pharynx, and a sense of constriction in the œsophagus. The pain soon extends to the abdomen, and vomiting ensues; the abdominal pain becomes aggravated; and usually purging sets in. The stools are numerous, often scanty, passed with great pain and straining; they are at first mucous, and finally bloody. If carefully examined, little iridescent specks—portions of the elytra of the beetle—may be observed in the fæces and vomited matters. These are of course only observable when the powdered insect has been broken; and they frequently escape observation. Up to this period of the case, should portions of the beetle not have been detected, there is nothing to distinguish the case from one of ordinary irritant poisoning; except, perhaps, that salivation and swelling of the salivary glands are usually prominent symptoms. The gastro-intestinal inflammation may be so intensely and rapidly developed, that death may occur from collapse before strangury, the diagnostic symptom, is developed. Generally, however, the course is somewhat different, genito-urinary irritation and inflammation setting in; the symptoms of which are aching pains in the lumbar region, frequent desire to micturate, with violent tenesmus of the bladder, till eventually a few drops of albuminous or bloody urine only can be passed, or none at all. Priapism, erotic excitement, and swelling of the genitals are of frequent, though not of constant, occurrence. Delirium, tetanic convulsions, or paraplegia, may be noted in some cases. Eventually the intolerable agony gives way to collapse, stupor, coma, and death. Abortion not infrequently occurs in pregnant women, the drug being one in common use as an abortifacient.

Diagnosis.—The intense strangury, the swelling of the genitals, and the bloody stools, will leave little or no doubt as to the nature of the case; and the presence of particles of the drug in the ejecta will be conclusive.

*Fatal dose.*—Less than half a drachm of the powder, and an ounce of the tincture, have alike proved fatal.

Treatment.—Evacuation of the stomach by the use of the stomach-pump, syphon-tube, or an emetic is the first indication in poisoning by cantharides. It is best to wash out the stomach well. Mucilaginous drinks, white of egg (not the yolk), and demulcents, may be freely given; but oil in any form is to be avoided, as tending to dissolve cantharidin. Opium by the mouth or rectum, or the hypodermic injection of one-third of a grain of morphia, is advisable. Leeches to the region of the bladder, warm fomentations, and warm sitz-baths may afford relief. Chloral should also be given, or the patient kept cautiously under the influence of chloroform. Collapse may be met by ammonia and other stimulants. The hypodermic injection of a few drops of ether is useful. There is no known antidote for cantharidin.

Thomas Stevenson.

**CHLORAL HYDRATE, Poisoning by.**—Synon.: Fr. *Empoisonnement par l'Hydrate de Chloral*; Ger. *Chloralhydratvergiftung.*

Poisoning by chloral hydrate is a very common occurrence, this medicament being frequently taken in fatal quantity by misadventure. There is reason to think that it is also largely used for suicidal purposes. The so-called 'chloral habit' is a growing evil. A syrup of chloral hydrate, containing about twenty-two grains of this substance per fluid drachm, is largely sold in this country under a patent-medicine stamp.

Anatomical Characters.—There may be an entire absence of any characteristic appearances after death by hydrate of chloral; and at most these consist in more or less modified signs of asphyxia—especially a dark colour of the blood, and pulmonary and cerebral hyperæmia.

Symptoms.—The most striking symptom of poisoning by chloral hydrate is the rapid supervention of quiet sleep, at first simulating natural sleep. In this stage the patient can be easily roused, but he speedily drops off again. The pupils are contracted; the respirations are full, deep, and regular; the pulse is not much affected. This condition rapidly deepens into full coma. The respirations slacken; and the pulse is either weak and slow, or, more commonly, rapid and irregular. The temperature of the body is reduced; the muscular system is totally relaxed. The pupils now dilate; and with feeble thready pulse, the anæsthesia and paralysis gradually end in death, preceded by lividity and collapse. Exceptionally, in fatal cases, burning pain in the mouth, fauces, and throat, and symptoms of gastritis have been observed. In one case of recovery the patient became idiotic.

Diagnosis.—The history of the case, or the finding of a vessel containing the medicine, coupled with the symptoms, will usually set all doubts at rest. Otherwise the case may be mistaken for poisoning by opium or other narcotic, for carbolic acid poisoning, or for cerebral congestion. The pupil is not so contracted as in opium-poisoning; and, as the coma deepens, it dilates instead of undergoing further contraction. There is an absence of the olive-green or black urine so commonly noticed in carbolic acid poisoning, of the peculiar odour of the breath, and of stains about the mouth and lips.

Prognosis.—This will depend upon the state in which the patient is found, and upon the length of time which has elapsed since the ingestion of the poison.

Treatment.—Evacuation of the stomach by the aid of the stomach-pump is the first step in the treatment of a case of poisoning by chloral hydrate. Emetics, unless given early, usually fail to excite vomiting. The patient must be roused, if possible, as in opium-poisoning (*see*

through alcohol, oil of cloves, and mounting it in balsam.

*Illumination.*—For the complete demonstration of the more difficult bacilli, for instance, B. tuberculosis, it is advisable to employ oil-immersion objectives, and a dispersive illumination such as that afforded by Abbe's condenser.

Opium, Poisoning by). The temperature of the body must be kept up by warm applications. Stimulants may be freely given, and hot coffee injected into the rectum. Strychnia ($\frac{1}{25}$ gr.) has been recommended for use as a counter-poison, by subcutaneous injection; also picrotoxine. The former is a dangerous remedy; the latter also would not perhaps be a safe antidote, if given in full doses. Inhalations of amyl nitrite, and artificial respiration are advisable.

Thomas Stevenson.

**CHOLESTERINE** (χολή, bile, and στερὸς, solid).—Synon.: Fr. *Cholestérine*; Ger. *Cholesterin; Gallenfett.*

Chemical and Physical Properties.—Cholesterine is a monatomic alcohol, represented by the empirical formula $C_{26}H_{44}O$, occurring as a normal constituent of the nervous tissue (51·9 per cent. of the solids of the white matter and 18·6 per cent. of the solids of the grey matter of ox-brain); and in minute quantities in bile (·25 per cent.); and in blood (·5 to 2·0 per 1000). When pure it occurs as white glittering scales, which consist of needles, when crystallised out from ethereal solutions; and of rhombic plates, often deficient at one corner, when derived from alcoholic solutions (*see* Microscope in Medicine). It is insoluble in water, alkalies, and dilute acids, but readily dissolves in ether, boiling alcohol, benzol, chloroform, and solutions of the bile-acids. It melts at 145° Fahr., and its solutions are lævorotatory. The crystals, heated with a drop of strong sulphuric acid, give a carmine-red colour.

Sources.—The exact physiological significance of cholesterine is not known, but it is generally regarded as a product of the metabolism of the nervous tissues which should be eliminated by the liver in the bile. Since little or none is found in the fæces, it is believed to undergo a change in the intestine into stercorin (Flint). It is also found in the yolk of egg; in some vegetables, such as peas and maize; and in olive and almond oils.

Pathological Relations.—The pathological occurrence of cholesterine is varied. It is increased in amount in all acute febrile conditions, and especially in those diseases of the liver leading to the retention in the blood of the bile-constituents, producing in such cases a condition known as *cholesteræmia.* The fluid of cysts, especially hydatid and ovarian, seems to be more liable to contain it than effusions into serous cavities; and on this ground it has been referred to in the differential diagnosis of ascites from ovarian dropsy. But it sometimes occurs in considerable quantities in hydrocele fluids, and it has been met with in old pleural and peritoneal effusions.

Cholesterine forms the greater bulk of most gall-stones, being formed into coherent masses by inspissated mucus.

In the caseous degeneration of pus and other inflammatory products, crystals of this substance are to be found.

In the urine cholesterine is never found in health, but it occasionally occurs in morbid states, and is especially likely to be met with when there is advanced renal degeneration.

W H. Allchin.



**CONIUM, Poisoning by.**—Synon.: Fr. *Empoisonnement par la Ciguë*; Ger. *Schierlingvergiftung.*—All parts of the hemlock plant (*Conium maculatum*) are poisonous. Both the leaves and fruit are used in medicine. Its toxic properties were known in ancient times; the plant was used for the destruction of criminals by the ancient Greeks, and there is no doubt that Socrates was poisoned by it. Death from conium in this country has perhaps always been the result of misadventure or suicide; but on the Continent the active principle of the plant, *conia*, an alkaloid, has been administered for the purpose of wilful homicide, death resulting from a dose of 10 to 15 drops.

Anatomical Characters.—The signs of asphyxia, engorgement of lungs and of the right heart, and a general venous condition of the blood, appear to be constant after death from conium. There is nothing else specially noticeable.

Symptoms.—Preparations of conium, as well as the alkaloid, or mixture of alkaloids, known as *conia*, when taken in toxic doses, produce excessive muscular weakness, beginning in the lower limbs, and extending gradually upwards, with giddiness and disordered vision. These symptoms are in some cases preceded by nausea and vomiting, with dryness or burning pain in the mouth and fauces. There is a desire to remain quiet, and a peculiar heaviness or drooping of the eyelids, the patient lying with his eyes shut. This, and the impairment of vision, appear to be due to paralysis of the ocular muscles. The pupils may be natural, but later they become dilated. The pulse is slow till death is actually impending. The paralysis progresses gradually upwards, till eventually heart and respiration are affected, more especially the former. Convulsions, and impairment of the mental faculties—hitherto intact—now set in; finally sensation is impaired, and death ensues from asphyxia.

Diagnosis.—The paralysis of motion, progressing gradually upwards, with unimpaired sensation, and the peculiar drooping of the eyelids, are perhaps diagnostic of the nature of the poison.

Prognosis.—As no antidote is known which counteracts the effects of conia, the prognosis must always be a guarded one, and will depend entirely upon the general condition of the patient.

Treatment.—The stomach must be emptied by the stomach-pump or syphon-tube, and well washed out. Emetics may also be used to evacuate the stomach. Tannin and astringents must be freely administered, to precipitate the active alkaloid, and prevent its absorption. Castor oil, by the mouth or rectum, may aid the removal of the alkaloid when it has been rendered insoluble by tannin. Strong coffee, brandy, ammonia, and stimulants generally are serviceable, as may also be the hypodermic injection of ether. Hypodermic injections of 1-40th grain of sulphate of atropia are very promising, especially in the later stages; atropia acting as a respiratory and cardiac stimulant. Artificial respiration, and stimulation of the respiratory and cardiac functions by the use of electricity, ought not to be neglected when these are affected.

Thomas Stevenson.

**DISTOMA RINGERI.**—Under this name there has lately been described by the writer (*Medical Times and Gazette*, July 8, 1882), a new species of fluke, the mature form of which inhabits the human lung, where it was first found by Dr. B. S. Ringer in Formosa, in 1879. The ova of the parasite have frequently been found by Prof. Baely, of Tokio, and the writer, and by them are associated with a peculiar form of recurrent hæmoptysis, to which the term *parasitical hæmoptysis* has been applied.

Symptoms and Pathology.—The symptoms of the disease associated with the presence of the distoma Ringeri are slight cough; the expectoration of a characteristic rusty brown, viscid mucus; and at times hæmoptysis, either to an insignificant or an alarming extent. The hæmorrhage occurs at irregular intervals during many years. The expectoration of rusty bronchial mucus is persistent, and in this the ova are readily discovered with the microscope. These ($\frac{1}{300}$ in. × $\frac{1}{500}$ in.) are pale brown bodies, oval, double-outlined, operculated at the broad end, and contain protoplasmic globules having very active molecular movements. If the sputum is occasionally shaken up in fresh water, in the course of six weeks to two months an active ciliated embryo is developed in most of the ova, which in time escapes by forcing back the operculum. It may be concluded from this that drinking water, or a fresh-water animal acting as intermediary host, is the medium by which the disease passes from one human subject to another. *See* Distoma.

This disease has hitherto been found only in Japan and Formosa, but its distribution is probably much more extended than this.

The mature distoma measures $\frac{14}{32}$ in. × $\frac{5}{32}$ in. × $\frac{1}{32}$ in. The particular tissue of the lung it inhabits has yet to be determined. It certainly communicates with the bronchi, as the bronchial mucus is the medium by which the ova are conveyed to suitable incubating media; but whether the animal is free in the bronchi, or is jammed into a branch of the pulmonary artery, has yet to be ascertained.

Treatment.—Inhalations of sulphurous acid, and sprays of turpentine, kousso, quassia, and santonine, have been administered with apparent benefit. Patrick Manson.

**FILARIA SANGUINIS-HOMINIS.**—Whilst the article Filaria Sanguinis-Hominis (p. 512) contains a sufficiently full account of the structure of this parasite, recent investigations enable us to furnish a more complete description of the life-history of the mature and embryo worm, and of their pathological relations to chyluria and elephantiasis. It is now known that the parent worm lives in the lymphatics; that the embryo while *in utero*, by dint of vigorous movements, stretches its oval chorional envelope, to form the long tubular sheath in which it lies extended, as we see it in the blood and lymph; and that, after this stretching of the chorion is complete, the embryo is born into the lymph-stream, which carries it through the glands, along the thoracic duct, and thus into the blood. Under ordinary circumstances of health and habit, the embryo cannot be found in the blood during the day, but at evening it appears there, in numbers gradually increasing up to midnight (when in some cases as many as 200 may be found in a single drop) and diminishing towards morning. About 8 or 9 A.M. it disappears for the day. This phenomenon ('filarial periodicity') is apparently an adaptation of the habits of the parasite to those of the female of a particular species of mosquito, which preys on the blood at night, and thus imbibes the young filaria, to which it acts as intermediary host. Having entered the stomach of the mosquito, the filaria undergoes a metamorphosis, eventuating in its becoming possessed of an alimentary canal, rudimentary organs of generation, increased size, great activity, and a circumoral crown of papillæ. The latter is the boring apparatus, which enables the animal to leave the body of the mosquito, when this insect dies, after depositing her eggs on water; and to traverse the human tissues, to which it gains access, probably by being swallowed in drinking water.

Pathological Relations.—Chyluria, nævoid elephantiasis or lymph-scrotum, varicose and indurated groin-glands, galactocele, ascites with milky fluid, *craw-craw*, and certain kinds of abscess, lymphangitis, and lymphatic fever, are almost invariably accompanied by the presence of the filaria in the blood or lymph.

As tropical elephantiasis is often associated with, or supervenes on, some of these affections, has the same geographical distribution, attacks the same parts, and is a disease of the lymphatics, it is therefore—though the filaria is not usually found in developed elephantiasis—believed to be caused by this parasite. But from the fact that in many countries where the filaria is endemic, quite 10 per cent. of the adult population harbour it, yet only a small proportion of these have any of the diseases enumerated, it is evident that the parasite does not necessarily give rise to disease. Evidence has been adduced which shows that, as long as the parent worm is healthy, it is innocuous, but that if it dies, it acts as a foreign body, causing abscess; and that the obstruction of the lymphatics, which eventuates in and causes the diseases above enumerated, is brought about by the premature birth of the embryo, before the chorional envelope has undergone the stretching process alluded to—that is, when ova (seven or eight times the diameter of the outstretched embryo) are prematurely launched into the lymph-stream. The ova act as emboli, and being very numerous, effectually plug the glands connected, directly or by anastomosis, with the lymphatic vessel in which the aborting parent lies. The location of the worm, the degree of embolism, and other circumstances, determine the site and exact character of the resulting disease.

Treatment.—*a. Curative.*—No means of killing the filaria have been discovered. The indications for treatment, when disease has developed, are supplied by the pathology. Rest, elevation of the affected parts, elastic bandaging, and other means to facilitate the flow of lymph through the damaged lymphatics are of great benefit. *See* Chyluria; and Elephantiasis.

*b. Preventive.*— The fact that the mosquito acts as intermediary host, indicates the direction that preventive measures should take. Drinking water, in districts where the filaria is endemic, ought to be boiled or filtered; wells, cisterns, and receptacles for drinking water ought to be covered by fine wire gauze, to prevent the access of the mosquito; and persons known to harbour the parasite, ought to sleep under properly constructed mosquito-curtains. By any or all of these means, this parasite in the course of a single generation could be exterminated, and the diseases it produces made things of the past.

PATRICK MANSON.

**LARYNX, Diseases of.**—The chief neuroses connected with the larynx, and the various forms of paralysis affecting the organ of voice, require more consideration than they have received in the principal article, LARYNX, Diseases of.

**1. Sensory Neuroses of the Larynx.**— *Hyperæsthesia* of the laryngeal mucous membrane is a usual accompaniment of inflammation, acute and chronic, and is a not unfrequent hysterical symptom. *Anæsthesia* occurs in cases where the superior laryngeal nerve or its centres are affected, and especially as a sequel of diphtheria. It is usually associated with paralysis of the muscles of deglutition, and of the depressors of the epiglottis, and still further contributes to the dysphagia accompanying the lesion, leading to pulmonary complications, owing to food passing into the larynx deprived of its reflex sensibility. If necessary, food must be administered by the œsophageal tube, while the nervous lesion is suitably treated.

**2. Paralysis of the Larynx.**—DEFINITION.— Loss of power in the laryngeal muscles, occurring in connection with disease or poisoning of the nervous centres, or with pressure upon or disease of the laryngeal nerves or their parent trunks, caused by aneurism, enlarged cervical or bronchial glands, or other tumours; more rarely of muscular origin.

VARIETIES AND SYMPTOMS.—Paralysis of the superior laryngeal nerve, supplying the crico-thyroid muscle, in addition to the symptoms mentioned under anæsthesia, prevents due tension of the vocal cords, and causes dysphonia. Complete paralysis of the muscles supplied by both recurrent laryngeals, the motor nerves of the larynx, causes the vocal cords to remain immovable and semi-closed, as in the dead body; but disease or pressure upon this nerve most commonly paralyses only certain groups or individual muscles. The most serious, and perhaps most common, lesion is paralysis of the *ab*ductors (posterior crico-arytænoids, &c.), causing the vocal cords to approximate in the middle line in a relaxed state. Even in phonation they are not tense; and during respiration only a narrow chink is left, with relaxed edges, causing very stridulous breathing, and possibly fatal asphyxia. Paralysis of the *ad*ductors, when one or both vocal cords are seen at all times relaxed and drawn aside, leading in the latter case to complete aphonia, and in the former to aphonia more or less complete, is not necessarily attended with much dyspnœa. When these conditions are of long standing, the muscles become atrophied; but many cases have been reported where the paresis of individual muscles has been of true muscular origin.

DIAGNOSIS.—The several varieties of paralysis of the larynx must be recognised by the laryngoscope, the symptoms to which they give rise being common to various diseased conditions. The dyspnœa and stridulous breathing of paralysis of the abductors is unaccompanied by the pain and other symptoms which attend them in the various inflammatory affections, but may without physical examination be undistinguishable from those caused by neoplasm or by passive œdema.

Functional aphonia has been considered in the body of the work (*see* LARYNX, Diseases of). Organic aphonia is not only a frequent symptom of painful inflammation, of ulcerations, neoplasms, and other affections of the larynx; but it may be the only symptom, not only of paralysis of the adductors, from disease of the nerves or muscles, but of other conditions closely simulating this, such as anchylosis of the crico-arytænoid joints (Dr. F. Semon), contracted cicatrices, and other mechanical obstacles to the approximation of the vocal cords.

TREATMENT.—The paralysed condition usually depending on serious disease outside the larynx, local treatment is of little avail. Tracheotomy may be called for to avert asphyxia. Cases where the local use of electricity is supposed to have cured paralysis were probably cases of simulated disease. *See* LARYNX, Diseases of; and PNEUMOGASTRIC NERVE, Diseases of.[1]

THOMAS J. WALKER.



**LICHEN.**—The general pathology of lichen is discussed in the body of this work. Here it is thought desirable to describe the several species of lichen, and to refer to certain other diseases which were formerly associated with each other under this generic name.

The somewhat loose definition given by the older writers to the word 'papule,' caused them to include under the head of *lichen* diseases, or rather conditions of the skin, many of which belong to other categories. Thus Willan's list included seven species:—1, *Lichen simplex*, 2. *L. pilaris*, 3. *L. circumscriptus*, 4. *L. agrius*, 5. *L. lividus*, 6. *L. tropicus*, and 7. *L. urticatus*.

*Lichen simplex* is merely a temporary lichenous condition—in short, the papular stage preceding the vesicular stage of eczema. *L. agrius* and *L. tropicus* may be disposed of in like manner.

*Lichen* or *Pityriasis pilaris* is an affection

[1] It seems desirable to refer here to the following points which have not been noticed in the article LARYNX, Diseases of.

*Dilatation of contractions* by bougies and plugs has been frequently attempted, and recently successfully practised by Schrötter and others.

*Perichondritis*, and consequent formation of *abscess*, with consecutive caries and necrosis of the cartilages, have been alluded to as complicating tubercular, syphilitic, and the worst forms of non-specific laryngitis (typhus, &c.); rarely it occurs as a primary affection, giving rise to a limited suppuration. Abscess is so rare a complication of simple laryngitis that its occurrence almost invariably indicates perichondritis, with its formidable results—necrosis, caries &c.

which is differently classed by authors; it is essentially a chronic condition, characterised by a heaping up of epidermis in horny masses round the hair-follicles, giving the part affected the feel of a rasp. The outer surfaces of the extremities, the backs of the hands and phalanges, are the seats of election; its alliances are with the squamous affections.

*Lichen circumscriptus* or *circinatus* is a well-defined affection, in which small red papules are seen arranged in groups, and especially in segments of circles. The area enclosed by the segments of circles is minutely scaly, and of a buff-pink colour. The seats of election are the sternal region, between the mammæ, and the interscapular region; from these, however, it may spread. The affection is very itchy, and has a strongly marked parasitic appearance, though the existence of fungus is extremely difficult, if not impossible, to demonstrate by ordinary methods. Dr. Crocker has, however, described and figured a fungus which he has found associated with L. circumscriptus. The affection readily yields to a little creasote ointment (♏ vj-x to the ounce of lard).

*Lichen lividus* is a purpuric condition, in which the purpuric spots appear as papules round hair-follicles. *See* PURPURA.

*Lichen urticatus* is an affection which is now classed as a variety of urticaria.

In accordance with the teaching of Hebra, modern dermatologists are disposed to restrict the term lichen to papular affections in which the papules retain their character as papules, and do not undergo any further evolution. There is another condition imposed, namely, that the papule must be inflammatory. The group Lichen is thus narrowed down to one of Willan's list, namely, *Lichen circumscriptus*; and two newly-described diseases, *Lichen ruber* and *Lichen scrofulosorum*.

*Lichen ruber* is a disease first described by Hebra, in Vienna, and in this country by Sir Erasmus Wilson, under the name of *Lichen planus*. Although denied by some, the essential identity of the two conditions described under these names is generally admitted. The characteristic feature of L. planus or ruber is the development round the hair-follicles of lilac-red, flat-topped, somewhat quadrangular, shining papules; in early stages a central depression or umbilication is recognisable in the centre of each papule. At first the papules remain discrete, but they soon tend to group themselves in patches, or run together in lines; the patches increase in size by the development of fresh papules in the immediate vicinity of the old ones. In this way whole areæ may become affected, the skin being then much thickened and slightly scaly. The patches itch intensely; and the clinical alliances of the disease are probably with psoriasis (Hutchinson). In its severest types, where the entire surface is affected, the patient's life may be threatened; but in milder forms it is very manageable by the internal administration of arsenic, combined with the local inunction of a mild tar ointment, such as ℞ Liquoris Carbonis detergentis ʒij. Adipis ʒi. Misce, et fiat unguentum.

*Lichen scrofulosorum* is another disease, first described by Hebra. It is extremely rare in this country, although it undoubtedly exists, especially amongst the poorer classes. It is characterised by pale papules, approaching the colour of the skin; these tend to range themselves in circular patches, not circles, generally on the trunk rather than the extremities. Here and there a papule inflames, and becomes acne-like. There is little itching. The disease is said to occur in young scrofulous subjects. Cod-liver oil is the remedy internally, and also externally by inunction.

ALFRED SANGSTER.

**LUPUS, Local Treatment of.**—Volkmann has recently introduced a method of treating lupus locally, namely, by *scraping* or *puncture*.

1. *Scraping* has for its object, first, the removal of products of secretion, scabs, and crusts; and, secondly, the removal of neoplasms formed in or on the skin. For this purpose 'spoons' or 'scrapers' of various sizes are made by the instrument-makers. It is difficult to make any impression on the sound skin with such blunt instruments, and on this fact the simplicity and safety of scraping mainly depend. It is almost impossible to do harm, for all that can be made to break down (using moderate force), under the scraper or spoon, is best removed.

2. *Multiple punctiform scarification* is the second mechanical method employed by Volkmann. By this the practitioner seeks, first, to destroy newly-formed vessels; and, secondly, to favour absorption of the neoplasm, by traumatic irritation of the part. It is practised by making hundreds of punctures close together, about two lines in depth. For this purpose a narrow-bladed bistoury may be used; or the same end is gained in less time by employing an instrument composed of two or more knives set close together. This method of treatment is more applicable to non-ulcerated parts, where the cell-infiltration is diffuse, or where the part is swollen and vascular. Such tissue might in some cases be made to break down under the spoon, but less scarring or deformity results if the neoplasm can be made to disappear by the method of puncture.

There is considerable bleeding at first, after either scraping or puncture. This, however, is soon controlled, by the application of sponges squeezed out in iced water. The part may be dressed after operation with some simple dressing, for instance, carbolized oil or lead lotion.

It is but rational to follow up the scraping by the application of caustics; for in most cases there must exist, deep in the skin, prolongations of lupus-tissue, extending from the mass on the surface along the hair-follicles and other vascular structures.

ALFRED SANGSTER.

**NUCLEUS OF CELLS, The.**—SYNON.: Fr. *le Noyau*; Ger. *der Kern*.

DEFINITION.—A minute mass of protoplasm imbedded in the substance of nearly all cells.

The nucleus differs from the cell-substance in its optical characters, and in its behaviour to certain chemical reagents; being, for example, more readily stained by various colouring matters, and presenting, as a rule greater resistance to weak acids and alkalies. Until recently it was

believed to form an essential part of all cells. *See* CELL.

CHEMICAL CHARACTERS.—Regarding the chemical characters of nuclei but little is known, beyond the fact that they contain, in all probability, an albuminous body.

MICROSCOPICAL CHARACTERS.—The intimate structure of the nucleus is very complex. In many animal cells, more especially gland-, epithelial, and endothelial cells, it is made up of a delicate network of fibres running in all directions, in the meshes of which is a substance of more or less fluid consistence, the whole being surrounded by a membranous envelope from which the fibres spring.

PHYSIOLOGICAL PROPERTIES.—It has long been believed that the nucleus plays a predominating *rôle* in the process of cell-multiplication; and this view has recently been materially strengthened by the discovery of the so-called *indirect division* of the nuclei of epithelial cells. Indirect division of the nucleus, or, as it is called by Flemming, *karyokinesis* (κάρυον, a nucleus, and κίνησις, movement) is the name applied to a complicated series of structural changes accompanying the division of the nucleus into two halves; and is employed in contradistinction to the term *direct division*, in which the nucleus, without any accompanying visible changes of structure, divides into two or more parts, called 'daughter-nuclei.'

The changes in karyokinesis consist chiefly in thickening of the intranuclear fibrils above referred to, and in disappearance of the nuclear membrane, accompanied by increase in the size of the nucleus as a whole, this being followed by a complicated series of changes in the form and arrangement of the intra-nuclear fibres, in the course of which they often present the most regular stellate, fan-shaped, or wreath-like figures, ending in their dividing into two bundles of fibrils which draw apart from one another. This is followed by separation into two halves of the nucleus as a whole, each daughter-nucleus containing a more or less complicated bundle of fibres in its interior. The division of the nucleus is followed by that of the cell, while the fibres of the nucleus gradually diminish in thickness, and arrange themselves in the form which they present in the 'resting cell.'

In cell-multiplication by *direct division* of the nucleus, no change in the intimate structure of the nucleus is to be observed; all that is to be seen is that the nucleus becomes enlarged, and, after assuming a dumb-bell shape, divides into two halves, which may themselves be again divided into two.

PATHOLOGICAL RELATIONS.—Karyokinesis is of considerable pathological importance, having been found to take place in the cell-multiplication of certain forms of epithelial cancer. On the other hand, direct division is the mode by which the nuclei of pus-cells multiply.

The nucleus is, as a rule, more resistant of retrogressive changes than the rest of the cell, often remaining apparently intact after the whole of the cell-substance and of the cell-wall has disappeared. In other cases the destruction of the nucleus goes hand in hand with that of the rest of the cell. Vacuolation of the nucleus is by no means rare, in cases of commencing retrogressive metamorphosis of cells, and also in cases of inflammation, for instance, of the skin.

CHARLES S. ROY.



**PTOMAINES** (πτῶμα, a dead body).—SYNON: Cadaveric Alkaloids; Fr. *Ptomaines*.—Under this name a class of bodies has been described, which are stated to be the basic products of the decay of animal matters, and to which Selmi and others have assigned poisonous properties. It is right, however, to state that although the existence of basic or alkaloidal bodies among the products of decay is highly probable, the definite toxic properties of these substances are by no means generally admitted; and their preparation, in a state of even approximate purity, has perhaps not hitherto been achieved.

Panum first showed that by the putrefaction of albuminous matters a soluble ferment is produced, which is poisonous. Fagge and the writer also showed, in 1865, that the alcoholic extracts of many *post-mortem* liquids taken from the human body are, even after exposure to the temperature of the water-bath, poisonous when injected beneath the skin of animals. Bergmann, Schwenninger, Sonnenschein, and Zuelze more or less confirmed these observations, and added to them. Selmi is, nevertheless, the observer who has chiefly worked at the cadaveric alkaloids.

According to Selmi ptomaines are alkaloids, generated during decay, and closely resembling the vegetable alkaloids, not only in their chemical reactions, but also in their physiological properties. Some ptomaines appear to be poisonous; and others to act as counter-poisons to well-known vegetable alkaloids. The conditions under which they are formed are entirely unknown, except that they may be found in alcoholic anatomical maceration liquids, and that exclusion of air possibly favours their formation. Some ptomaines have no marked physiological activity. Some are formed even in the living body, during the progress of such diseases as peritonitis.

The chief interest attaching to the ptomaines arises from their liability to be confounded with other and well-known natural alkaloids, such as morphia, strychnia, &c.; and hence to lead to mistakes in medico-legal practice. Brouardel and Boutiny nevertheless have, as they assert, discovered chemical reactions by which the ptomaines as a class may be distinguished from the natural alkaloids.

THOMAS STEVENSON.

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